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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURE

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NOTES ON THE ABORIGINES OF SOUTH AMERICA.

Aborigines of South America. By the late Colonel G. E. Church. Edited by an Old Friend, Clements R. Markham, K.C.B. Pp. xix + 314. (London: Chapman & Hall, Ltd., 1912.) Price 10*s.* 6*d.* net.

THE author of this posthumous work was a descendant of the earliest New England colonists. Born in 1835, he became a surveying engineer, and his first introduction to South America was of a kind sufficient to shape his whole career. As a member of an expedition sent out by the Government of Buenos Aires in 1859 to explore the south-western frontiers, he partook of severe fighting with the then still unsubdued Araucanians and Patagones. Then he served through the whole of the Civil War in the United States, and next he joined the General Staff of Juarez against Maximilian. After that episode we find him in Bolivia, which he reached once by Buenos Aires, another time by Peru, busy with concessions of the navigation of Bolivian and Brazilian rivers. A political mission to Ecuador, the building of an Argentine railway, business in Panama, Costa Rica, and elsewhere afforded him well-nigh unrivalled opportunities of studying land and peoples of South America before he settled down in London, where he devoted much time to his favourite geographical and ethnological studies.

The author's intention to write a comprehensive work on the aborigines of South America was frustrated by his death in 1910, and only the less incomplete chapters have been edited by his friend, Sir C. R. Markham, himself a traveller in those parts of the world. They are apparently not so much notes by the experienced, observant traveller as critical, carefully sifted extracts from the numerous accounts of previous explorers, whose accounts alone can bear upon the "history" of these wild, roaming, barbaric tribes. In many cases the bewildering number of names, mostly nicknames bestowed upon each other by the various clans and muddled by the Europeans, have been reduced to synonymic order. Presumably all the aborigines of the whole continent are of one stock, but time and separation and environment have diversified them. One of the most vigorous were the Caraios, Caraibes, Guaranis, or Tupis, with their origin in Paraguay, whence this dominant race made its influence felt from La Plata to Orinoco and spread even to the Antilles. Several chapters are devoted to the unravelling of the resulting dislodgment of the coast-tribes of Brazil and those of Amazonia, and to the troubles brought upon them by the Portuguese and Spaniards. The scanty notes made by the white man, not always well educated, be he soldier, trader, or missionary, about customs, arms, and ornaments, are often the only facts known about many a so-called tribe.

Within late Tertiary periods the whole continent seems to have been divided into an eastern and a western half, from Uruguay to the Orinoco, by a system of enormous lakes. Our author evidently believed that such a division still existed when man already inhabited South America, before the Pampean and Amazonian inland seas and other lakes, of which Titicaca is a remnant, had yet been drained by the present great river systems. This somewhat rash idea is on a par with the suggestion that South America may have been connected with Africa or Australia via Antarctica at a period when climatic conditions made these dreamlands a pleasant abode for man and thus account for the puzzling origin of the Patagonians.

HYDRAULIC MACHINERY.

Modern Pumping and Hydraulic Machinery: Being a Practical Handbook for Engineers, Designers, and Others. By E. Butler, Pp. xvi + 473. (London: C. Griffin and Co., Ltd., 1913.) Price 18*s.* net.

AN examination of this important work brings home to the reader some idea of the enormous extent and ever-increasing variety of machinery that is used in connection with hydraulics; for, although this treatise is devoted to the consideration of the wide range of machinery and appliances connected with almost every known type used in pumping operations, the amount of other classes of hydraulic machinery which the exigencies of space excluded would well fill the pages of another volume. For this reason the subtitle is too comprehensive and rather misleading, as the book does not deal with hydraulic machinery "as applied to all purposes"; but, it is fair to say, the author has wisely restricted its scope to enable him to deal comprehensively with the sections selected, and in a broad way included in the title "pumping machinery." The ground chosen has been covered in an exhaustive and systematic way, and a glance at the contents shows how varied is the machinery dealt with, for it embraces machinery used for water-supply, wells, mines, drainage, irrigation, dredging, reclamation work, and for raising petroleum from deep wells, and a chapter is devoted to hydraulic power wheels and turbines.

There is no lack of admirable books on the theory of hydraulics and of hydraulic machines, but the many important developments and improvements made in hydraulic machinery in recent years have doubtless created a demand for just such a book as Mr. Butler has so ably produced, and the information it contains cannot fail to be of use to the practical engineer and others engaged either in the construction or application of hydraulic machinery, to say nothing of its educational value to the engineering student. The designer will also appreciate the book, as it contains a wealth of detail and descriptive matter, but his requirements as to the proportioning of parts have not received the attention they might with advantage have had given to them here and there in a treatise of this type. No better work than Seaton's "Marine Engineering" can be cited as an example of what can be done in this direction to help the designer. The Humphrey gas-displacement pump, the most important invention in pumping machinery made in recent years, is fully described, and the author gives some particulars of previous inventions of this type, but omits to mention that the first-known internal combustion pump was Tatham's, patented about 1894, and referred to in the discussion on the Humphrey pump at the Institution of Mechanical Engineers.

The illustrations are extremely well reproduced, with few exceptions; for instance, the longitudinal sections on p. 387 look rather too confusing to be easily read, owing to their coarse section lining. On the other hand, the diagram on p. 377, showing development of vane curvature in an impeller wheel, is admirable.

The book is a notable addition to the literature of the subject, and should be well received.

H. J. S.

MIND, HEALTH AND PURPOSE.

(1) *The Game of Mind: A Study in Psychological Disillusionment.* By Percy M. Campbell. Pp. iii + 80. (New York: Baker and Taylor Co., 1913.) Price 75 cents net.

(2) *Mind and Health. With an Examination of some Systems of Divine Healing.* By Dr. E. E. Weaver. With an Introduction by Dr. G. Stanley Hall. Pp. xv + 500. (New York: The Macmillan Company; London: Macmillan & Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

(3) *Development and Purpose: An Essay towards a Philosophy of Evolution.* By Prof. L. T. Hobhouse. Pp. xxix + 383. (London: Macmillan & Co., Ltd., 1913.) Price 10*s.* net.

(1) IN "The Game of Mind" Mr. Campbell puts the question: "To what extent does the mere reiteration, by the possessor of a toothache, of the complaint that he is indeed feeling pain, influence or *constitute* that pain? In other words, If the victim were so organised that he need not perforce tell himself each instant that he is being hurt, would the hurt exist as such at all?" And Mr. Campbell replies: "We are convinced that it would not." Mr. Campbell, of course, discusses many other questions; but his method of argument displays the same degree of cogency throughout.

(2) In "Mind and Health" Mr. Weaver discusses "some of the distinctive religious and philosophical systems of healing," and lays down "the plan of a valid system of healing on religious ground." The first element of "a valid religious psychotherapy" he declares to be that "sickness comes from want of goodness." "Goodness" is, of course, an ambiguous term; and Mr. Weaver very properly describes the sense in which he uses it: "A goodness that starts in the spiritual and will be allowed to work unfettered and unhindered in the intellectual, emotional, and physical life will not be sick. It knows no sickness." If goodness of this kind—a goodness which knows no sickness—is to be pro-

duced in the patient, then it must first be possessed by the practitioner: "The power of healing released through a religious psychotherapy should be mediated by the minister of religion." If so, then, Mr. Weaver argues, the Christian Church must carry on the ministry of religious psychotherapy. Mr. Weaver's fundamental assumption, then, is: Be good (or get someone to make you good) and you won't be ill. It is a defect of his book, however, that he does not convince the reader of the truth of the assumption.

(3) Mr. Hobhouse's "Development and Purpose" is a contribution to philosophy, serious, solid, and certainly heavy. "The book completes a scheme which has occupied the writer for twenty-six years, and has been carried through successive stages in three previous works." But the scheme has come to be completed in a way which a quarter of a century ago Mr. Hobhouse did not foresee or intend. He has come to hold that in the process of evolution both mechanical causation and teleological causation are at work; and, what is more, that mechanical causation involves teleological causation—hence, according to Mr. Hobhouse, the "organic harmony" of the world process.

Intelligent action is truly purposive, that is to say it is teleological causation and is not resolvable into mechanical laws. The actual order of reality, he tells us, is determined by the impulse to realise the future: what we do now is determined by what we want to be or do in the future. But, if that is so, it seems to the reader as though no place were left for mechanical causation, no need for causes prior in time to their effects. Mr. Hobhouse, however, holds that mechanical causation involves teleological causation, *i.e.* apparently that there could be no cause prior in time to the effects unless there were causes which, being teleological, are not prior in time to their effects. From this it would seem that the source of the trouble lies in the assumption that causes must be in time; on that assumption causes must both be and not be prior in time to their effects.

Mr. Hobhouse, though he sees and says that in the more ultimate sense Reality is not in time, but time is in Reality, does not devote more than this single sentence to the way in which, as it seems to us, the notion of time refracts causation into mechanical and teleological causes. However, Mr. Hobhouse's services to the cause of philosophy are recognised by all interested in philosophy; and all will be glad that the University of Durham has, in recognition of those services, conferred upon him the honorary degree of D.Litt.

IRON AND STEEL METALLURGY.

(1) *Iron Making in Alabama.* Third Edition. By W. B. Phillips. Pp. 254+xxxi plates. (Alabama: The University, 1912.)

(2) *Iron and Steel: An Introductory Text-book for Engineers and Metallurgists.* By O. F. Hudson and Dr. G. D. Bengough. Pp. x+173. (London: Constable and Co., Ltd. 1913.) Price 6*s.* net.

IT would be difficult to find a better illustration of the wide range of subjects involved in the study of iron and steel than these two books. Whereas one deals mainly with the extraction of iron from its ores, the other is largely concerned with the properties of the recovered metal, and the subjects range from the mining of the ore and the washing of coal on the one hand, to the constitution of steel and the electrolytic theory of corrosion on the other.

(1) The book by Mr. Phillips is published by the Geological Survey of Alabama, and is of necessity somewhat statistical. It is seldom, however, that one finds statistics dealt with in such an interesting manner. The title of the book might more accurately and with advantage be described as "Iron and Steel Making in Alabama," for it includes an excellent account of the steel-works of the State, which are responsible for an annual output of nearly half a million tons of steel in all sections, from rails to wire.

The first part of the book deals exhaustively with the iron ores of Alabama, and a chapter is devoted to experimental work on concentration. Fluxes and fuels are then considered, and much useful information is given on coking practice and the employment of by-product coke ovens. Blast-furnace practice, as regards both coke and charcoal furnaces, is considered in detail, and the growth and development of the modern blast-furnace is traced from the year 1894 to 1910. This is followed by an excellent account of the steel-works and rolling-mills of the State, and finally there is a chapter on coal-washing. Not the least useful feature of the book is the large number of tables of statistics, and some reference must be made to the excellent series of illustrations, thirty in number, which are reproduced from photographs.

The extent of the iron and steel industry in Alabama may be gauged from the fact that in the year 1910 nearly five million tons of ore were mined and sixteen million tons of coal, of which five million tons were converted into coke. The production of pig-iron amounted to two million tons, and of steel half a million tons. Such an industry is of more than local importance, and

Mr. Phillips's volume will be greatly appreciated not only by those who are connected with Alabama, but by all who are interested in the manufacture of iron and steel wherever it may be carried on.

(2) Mr. Hudson's book is one of a series of text-books which are described as "introductory to the chemistry of the national industries." It is written in a clear and concise manner, and deals very ably with recent scientific investigations and theories regarding the constitution of iron and steel. The principles underlying the smelting of iron, the manufacture of wrought iron and steel, foundry practice, and such processes as case-hardening, welding, &c., are reviewed very briefly, but no attempt is made to treat these subjects from the manufacturing point of view, and this part of the book can scarcely be regarded as an introduction to the metallurgy of iron and steel, except for very elementary students. The book is intended primarily for those interested in the physico-chemical rather than the practical aspects of the subject, and this is clearly the intention of the author, who states in his preface that "practical details of the methods of production have been avoided almost entirely, in order that more attention may be devoted to such matters as an explanation of the constitution of steel and cast-iron, and the effects of mechanical and heat treatment on the properties of these alloys." In the later chapters these subjects have been very completely dealt with, and, together with the chapter on corrosion by Dr. Bengough, will be welcomed by many students of metallurgy.

OUR BOOKSHELF.

Ueber kausale und konditionale Weltanschauung und deren Stellung zur Entwicklungsmechanik. By Wilhelm Roux. Pp. 66. (Leipzig: W. Engelmann, 1913.) Price 1.50 marks.

PROF. ROUX makes game of Prof. Verworn's recent essay on the causal and the conditional outlook on the world, which was, we think, reviewed some months ago in NATURE. What is true in Verworn's essay is not new, and what is new is not true. The causal outlook, which has been in vogue "from the Stone age down to Verworn," is not to be superseded by a crude "conditionism." What is sound in Verworn's emphasis that the scientific task is to inquire into all the antecedent conditions is recognised by all investigators. The change proposed is verbal, for as soon as a process is set a-going, its conditions become active factors or causes. The complete conditions *are* the complete causes. Verworn lays great stress on what he calls the "effective equivalence" of the conditions of any process or result, but Roux cannot accept the phrase. Equally necessary the factors are, but certainly not equivalent.

In the study of development the *specifitas potentiae* of each of the various factors is well known. In vital processes the internal and the external conditions cannot be spoken of as equivalent, as Verworn proposes. The constitution of an ovum includes factors which determine a certain, within limits, typical result; the external conditions of oxygen, warmth, moisture, and so on, activate and sustain the development. Thus Roux distinguishes between "determining" and "realising" factors, and says that it is nonsense to speak of their "equivalence."

From time to time in his brilliant series of studies in "developmental mechanics" Roux has given a causal analysis of the known factors involved, distinguishing, for instance, between internal and external, determining and realising, necessary and "not necessary" factors; and he is entirely opposed to the false simplicity which Verworn's "conditionism" would suggest. There has been hard hitting on both sides, but perhaps it is instructive to remember that Verworn's life has been largely spent in the study of metabolism, and Roux's in the study of development—which is for him an "autophænesis," "a becoming-visible of manifoldness by the proper activity of the germ." J. A. T.

Brazil in 1912. By J. C. Oakenfull. Pp. viii + 498. (London: Robert Atkinson, Ltd., 1913.) Price 5*s*.

THIS is the fourth annual edition of an excellent handbook on Brazil. As usual, it is well and profusely illustrated, the large map of the country and the coloured frontispiece showing the precious stones of Brazil being especially good. The book deals in an interesting manner with the history and geography of Brazil; but the chapters on the anthropology and ethnography, the geology and palæontology, the mineralogy, and the agriculture of Brazil will appeal more directly to scientific readers.

The book is intended for free distribution, but duplicate and trade copies can be obtained at the price stated.

Teachers of geography will find it an interesting and valuable work of reference in the school library.

The Theory and Design of Structures. A Textbook for the Use of Students, Draughtsmen, and Engineers engaged in Constructional Work. By E. S. Andrews. Third edition. Pp. xii + 618. (London: Chapman and Hall, Ltd., 1913.) Price 9s. net.

THE first edition of this book was reviewed at some length in the issue of NATURE for March 18, 1909 (vol. lxxx., p. 64). The additions made to the present edition are incorporated in an appendix of some twenty-seven pages, and these include a note on Dr. Stanton's experiments on wind pressure. The notation in the chapter on reinforced concrete has been made to agree with that proposed by the Concrete Institute, and numerous exercises have been added to the volume.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Spectra of Helium and Hydrogen.

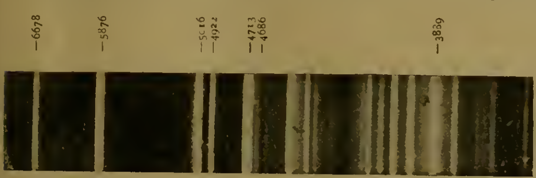
THE spectra of helium and hydrogen have acquired considerable importance in view of the recent experimental researches of Prof. Fowler and the theoretical investigations of Dr. Bohr. Before the appearance of Fowler's investigation the only hydrogen series known terrestrially were the diffuse series, consisting of the Hα, Hβ, &c., lines, and the infra-red series predicted by Ritz, two members of which (18751·3 and 12817·6) were observed by Paschen. However, by passing a strong condensed discharge through mixtures of helium and hydrogen, Fowler was able to photograph four members of the principal series, the strongest line of which is at 4686.

It should be noted that the 4686 line appeared on the photograph of the spectrum of a helium tube, which had been taken at the Solar Physics Observatory at South Kensington several years ago. Sir Norman Lockyer and Baxandall in their paper pointed out that the terrestrial line was very probably identical in origin with the chromospheric line of nearly the same wave-length photographed during the eclipse of January, 1898. They also noticed that the 4685·90 chromospheric line is of the same nature as the helium eclipse lines, being long and sharply defined. They concluded that the line is probably due to a gas, which is associated in some way with helium. The 4686 line has also been observed in the spectra of stars of the fifth type, and in the spectra of certain nebulæ, and had been attributed to hydrogen in accordance with Rydberg's calculations, which depend on the numerical relations existing between the different series.

In addition to the series having the 4686 line as first member, Fowler was able to photograph three members of the sharp series, which are found in the spectrum of ξ Puppis, and three members of a new ultra-violet series, which he calls the second principal series of hydrogen. According to the theory put forward by Dr. Bohr, the two principal series and the sharp series are given by helium. Also it should be possible to obtain the diffuse series from helium containing no hydrogen when the sharp series appears.

For some time I have been investigating the origin of the 4686 line, and the experiments already carried out support Bohr's theory. The chief difficulty consisted in driving out hydrogen from the poles of the helium spectrum tube, but this was accomplished so far as spectroscopic evidence goes. No hydrogen could be detected in the bulbs and capillary when heavy discharges from a coil capable of giving a 20-in. spark were passed through the tube. The 4686 line was strong in the capillary and fairly strong in the bulbs. The pressure of helium employed in these experiments varied from about 0·25 mm. to 1 mm. The capillary, in addition to the helium spectrum and the 4686 line, showed impurity lines due to oxygen.

Photographs I. and II. show the spectra obtained when a strong condensed discharge is passed through helium at pressures of 1 mm. and 0·3 mm. respectively. In the first photograph the 4686 line is of nearly the same intensity as the 4713 helium line, and the two are scarcely separated in the reproduction. The low-pressure photograph (Fig. 2) shows the 4686 line much stronger than the 4713 line. In both cases the hydrogen lines at 6563 and 4861 are not seen. The 4686 line could not be obtained from an ordinary hydrogen tube, nor from a neon tube containing a small amount of hydrogen as impurity. A tube containing a mixture of hydrogen and purified argon was also prepared, but the line was not visible when heavy condensed discharges were passed through the mixture.



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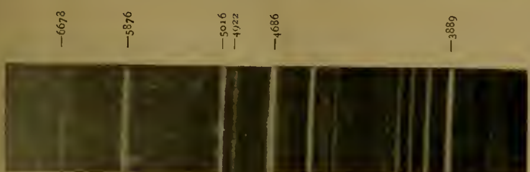

II.

E. J. EVANS.

The University, Manchester,
August 11

Coloured Organisms on Sea-Sand.

A VARIED and interesting field of investigation awaits the microscopist who will make a detailed examination of the minute fauna and flora of apparently barren sands on the seashore. To-day, on landing at the island of Oronsay at low tide, the otherwise pure white sand was seen to be coloured pink in one area, for an extent of several yards, green a little further up the beach, and golden-brown in small patches here and there. On examining samples with the microscope the brown colour was found to be due to living diatoms (*not* dinoflagellates in this case), naviculoid forms like Caloneis; the pink is formed of amorphous masses of fine granules in a jelly loosely adhering to the sand-grains, and may perhaps prove to be bacteria in a zoogloea state, while the green is caused by patches of a very simple alga (? a Coccophycid) made up of groups of rounded green cells in a single layer on the sand-grains. I have kept samples of all the organisms and will submit them to a botanist for more precise identification. No Amphidinium patches were present so far as I could see. The variety of organisms present in the one little bay, the extraordinary abundance in each patch, and the brightness of the colour produced on the white sand were very striking, and seemed worthy of note.

The colour was not in any of these cases due to the sand-grains themselves, which are mostly clear quartz with, as usual, a few black specks and some white shell fragments. Nor was there apparently any fresh-water on the beach, and certainly not any sewage or other source of impurity. It is a lonely, sandy bay, inhabited only by sea-birds and seals, and the nearest house is on the opposite side of the island at least four miles away by the coast. The sea-water seemed very clear, of salinity 26·5, and the sandy bottom could be seen from the yacht anchored in five fathoms.

Diatom patches are no doubt abundant in many places; probably the simple green alga encrusting the sand-grains is known to botanists, and I have certainly seen the pink organism elsewhere. Probably other coloured patches due to micro-organisms are present on many beaches. It would be interesting to have them more thoroughly investigated—biochemically, if possible—by someone living on the spot, and able to study their changes day by day.

W. A. HERDMAN.

S.Y. *Runa*, Sound of Islay, August 27.

Physiological Factors of Consciousness.

MR. ABDUL MAJID (NATURE, August 28) asks: "What is the true explanation of the fact that stimuli sufficiently strong to arouse vivid sensations in a subject while he is wide awake apparently fail to arouse any sensations at all in a state of unconsciousness?" But is there any evidence that stimuli do not arouse identical sensations in the waking and the sleeping states? As a medical man, I am frequently "rung up." As far as I am able to judge, I am invariably awakened out of a dream. I am never dreamless. My consciousness never sleeps.

But, in proportion to the depth of slumber, memory appears to be abolished. Memory is ample in proportion as it is clear and coherent—in proportion as it links the present with the past and so fulfils its function of affording a guide for the future. In dreams, since it is so much in abeyance, we live almost wholly in the "immediate present," taking little thought of the past or the future. Absurd or improbable happenings do not then surprise us; for these do not then contradict stored experience. On that account, also, we seldom remember our dreams unless they occur in light slumber (half-wakefulness), or unless our attention is called to them immediately on waking while our minds are still tingling with them. I am sure, if anyone tries the experiment of having himself awakened for a few occasions by the insistent question, "What are you dreaming about?"—if his attention is immediately fixed on his dream—he will soon be convinced that there is no such thing as dreamless sleep.

By way of illustration; I remember a terrible dream. An enemy had his hand on my mouth and was suffocating me. I awoke to find the tail of my friend the cat, who had come on his morning visit, laid across my lips. The dreams of ill-health, and especially of indigestion, are usually unpleasant and sometimes fearful.

I take it, then, that sensations are the stuff that dreams are made of. They are the same sensations that we feel in our waking states, but, when woven into our dreams, they are wrongly interpreted.

G. ARCHDALL REID.

Netherby, Victoria Road, S. Southsea, August 29.

The Elephant Trench at Dewlish—Was it Dug?

THE question of the brain capacity of the Piltdown and other fossil skulls must be decided by anatomists; but a sidelight may be thrown on the subject of the intelligence of early man by a consideration of the works of which he was capable. The most indestructible of these, and consequently the most frequently referred to, are worked flints. Upon their testimony Mr. Moir, and those who agree with him, would carry man's work back to the Pliocene period of the Suffolk Crag. Mr. Moir kindly allowed me to see a few of his specimens, and I am inclined to think that some of them show artificial chipping. The deposit in which the Piltdown skull was found is said to be early Pleistocene. Have we any indication of man's work between this and the Crag period? In my opinion we have. I refer to the remarkable trench at Dewlish, Dorset,[1] which before it was excavated contained abundant remains of *Elephas meridionalis* and no other fossils, though Mr. Grist has found eoliths.[2] It is difficult to account for the formation of this peculiar trench in chalk by any natural process. Mr. Clement Reid, who spent four days to examine it, tells us that "the fissure, or rather trough, ended abruptly without any trace of a continuing joint. It was not a fault, for the lines of flint nodules corresponded on each side. [3] Mr. Reid, at the British Association at Cambridge, described the termination of the trench as "apse-like." It opened out diagonally at one end on to the steep slope of the side of a valley. It was 103 ft. long and 12 ft. deep. The width, as the photographs show, was not quite uniform, and Mr. Reid said that in the narrow place he could just get along. It is remarkable that here the walls approach from each side—a feature apparently incompatible with any natural causation. After the trench had been refilled, I met with a description and photograph of a pitfall for elephants in Africa; and that led me to believe that this trench was artificial, and dug out for the same purpose.

If this view is correct, it shows that man existed in Pliocene times, and was already a social being capable of a great undertaking, for no one individual could have effected such a work.

My hope is that this trench may be reopened for the express purpose of testing this question. It has never been bottomed except at the end where it opened on the valley. Elsewhere two or three feet remain undisturbed. If it was artificial, some indication of the tools used might possibly be found at the bottom. The expense could not be great, and my object in writing this is to endeavour to excite such interest in the subject as may perhaps lead to a proper investigation. But a competent geologist, whose verdict would carry weight, ought to undertake it.

Graveley, Huntingdon. O. FISHER.

Note on the Dicynodont Vomer.

IN 1898 I directed attention to the fact that the paired elements in the front of the palate of lizards and snakes seem in all their relations to agree with the pair of bones in Ornithorhynchus, which afterwards fuse to form the dumb-bell bone, and that they cannot be homologous with the median unpaired vomer of mammals, and must have another name, and I proposed to call them *prevomers*. While the embryological evidence seems conclusive, the palæontological testimony has not hitherto been so satisfactory as one could desire. Cynodont reptiles appear to have a single median vomer, very like that of the mammal, and one specimen of Gomphognathus shows what appear to be a pair of elements in front. Dicynodon appears to have also a single median vomer, and no paired elements. The Therocephalians, on the other hand, have a pair of large anterior elements, and apparently no median element. With the palæontological

1 See paper by the writer with two photographic views, *Quart. Journ. Geol. Soc.*, 1905.

2 Journ. Roy. Anthropological Institute, vol. xl., 1910.

3 See "Geological Survey Memoirs," 1899, p. 54.

evidence in this condition, it is not surprising that the theory, though fully accepted by a few, and hesitatingly by others, has failed so far to be generally adopted.

For the last ten or twelve years I have constantly been on the look-out for a specimen which, while possessing a large median true vomer has also a pair of large distinct paired prevomers. Mr. D. M. S. Watson believes he has discovered in the British Museum a specimen of Lycosuchus showing a median vomer between the pterygoids, and certainly a pair of large prevomers in front. Unfortunately, though the specimen is satisfactory enough for those who believe the median vomer to be quite a different element from the reptilian paired "vomers," it is not convincing enough for the doubter.

In two species of the small Upper Permian Therocephalian genus Ictidognathus, I find a peculiarly complicated but single median vomerine bone, but in a third species, closely allied, I find clear evidence that the apparently single bone is composed of the paired prevomers anchylosed. Further, the anchylosed prevomers have exactly similar relations to the palatines and pterygoids that the median bone in Dicynodon has, and at first it looked as though the theory had received a severe blow.

Fortunately a specimen of a large species of Dicynodon has just been discovered that clears up all the confusion. The median bone, which lies between the posterior pairs in Dicynodon is the anchylosed prevomers. Above it, and completely concealed by it, is a large, well-developed, typically mammalian median vomer extending from the basisphenoid behind to the premaxilla in front. Along its upper side the vomer is grooved for the large basal and ethmoidal cartilages. Posteriorly it is closely united to the basisphenoid. The bone completely confirms the view I expressed in 1898 that the mammalian vomer is the reptilian parasphenoid, and quite a different element from the prevomers.

R. Broom.

American Museum of Natural History,
New York, August 10.

THE TWELFTH INTERNATIONAL GEOLOGICAL CONGRESS.

The first meeting of the International Geological Congress in Canada, and the third in the western continent, held its session in Toronto from August 7 to August 14, under the presidency of Dr. F. D. Adams, of McGill University. Altogether 1152 members were enrolled, about half of whom attended the meeting; and forty-six countries were represented by their leading geologists. Probably never before had Canada entertained a gathering so distinctively international, and great interest was manifested in the work of the congress, not only in Toronto, but throughout the Dominion. The honorary president of the congress, H.R.H. the Duke of Connaught, who was unable to attend, was represented at the opening session by the Right Hon. Sir Charles Fitzpatrick, Chief Justice of the Supreme Court of Canada, and by him a warm welcome to the Dominion was extended to the visiting delegates in a graceful speech in French, the official language of the congress. Ontario was represented by the Hon. W. H. Hearst, Minister of Mines for that province, Toronto by Alderman Church, and the University of Toronto by President Falconer, to whom the congress was indebted for the use of several of the university buildings during the meetings.

The chief work delegated to the twelfth congress had been the preparation of a monograph on the coal resources of the world, to serve as a companion work to the iron resources of the world, prepared for the eleventh congress at Stockholm. The general secretary of the congress, Director Brock, of the Canadian Geological Survey, presented the monograph, and summarised its main features. It consists of three quarto volumes, accompanied by a 68-page atlas, and contains reports from sixty-four different countries. The editing has been in the hands of a committee of the Geological Survey of Canada, consisting of Messrs. McInnes, Leach, and Dowling. Mr. Brock contributes the preface, Mr. Dowling an introduction summarising the main reports, while contributions by experts from the various countries of the world form the major part of the work. The total coal resources of the world are estimated at 7,397,533 million tons, of which 4,000,000 million tons are bituminous, 3,000,000 million tons brown coal, and the remainder anthracite. As the world's production in 1910 was 1,145 million tons, the exhaustion of our coal supplies is by no means an immediate problem. Approximate reserves of some of the chief countries are as follows:—Canada, 1,234,269 million tons; United States, 3,214,174 million tons; United Kingdom, 189,535 million tons; France, 17,585 million tons; Germany, 85,551 million tons; Russia, 233,997 million tons. In Switzerland only 4500 tons of coal remain. The preparation of the monograph involved a large amount of special investigation in several of the countries from which reports were submitted; and the three volumes, with the atlas of beautifully executed maps, will serve as a fitting companion volume to the iron resources of the world.

In order to facilitate business, the congress resolved itself into three sections, which met concurrently. Over eighty papers were presented, the majority of which had direct bearing on the topics which had been suggested for the consideration of the congress. On the subject of the differentiation of rock magmas the session was interesting, rather because of the variety of hypotheses than because of any distinct contribution to views already propounded elsewhere. Daly advocated stoping and gravitational movement, Harker fractional crystallisation, Lœwinson-Lessing differentiation in liquid state, Evans immiscible liquid phases, while Bergent emphasised recurrent basic and acid succession in its bearing on the problem. Iddings and Washington pointed out from different points of view the necessity of sufficient analyses within petrographical provinces. Hobbs referred to the relationship between certain petrographical provinces and clay states, and Cross discussed Hawaiian lavas from the point of view of the Atlantic-Pacific classification. Báckström, in summing up the discussion, advocated the conservative attitude until experimental work was sufficiently advanced to justify broad conclusions.

The theme "The Influence of Depth on the

Character of Metalliferous Deposits" was of special interest to economic geologists and mining engineers. Kemp dealt generally with primary and secondary precipitation; Krusch with colloidal precipitation of primary and secondary ores; Emmons with experimental evidence bearing on the precipitation of gold, silver, and copper, and the effect of the primary ores; Fermor with the action of oxygen and carbonic acid at considerable depths; Fanning with ore occurrences in the Phillipines. In the general discussion, in which Lindgren, Winchell, Lawson, Kitson, and others took part, the question of the formation of veins consequent on mineral crystallisation, and that of secondary gold deposition from placers, were taken up.

What were perhaps the most interesting discussions to the majority of the members of the congress were those on the sedimentation and the correlation of the Precambrian. The excursions provided to the vast Precambrian areas of Canada had attracted to the congress authorities from the Precambrian fields in all other countries; and the discussions were illuminating in that they focussed the experience of work in many fields on the intricate problems presented. The succession in Finland was given by Sederholm, who also illustrated by slides some clear instances of granitisation on a regional scale. Cole explained the intrusive relationships in north-west Ireland. The difficulties encountered by Scottish geologists in correlating the Precambrian of the Highlands were explained by Horne. An outline of the Precambrian of the British Isles was given by Strahan. Holland pointed out the broad similarities between the series in India and in North America. Coleman and Collins dealt more particularly with the area east of Lake Superior. A rather keen discussion took place when the classification submitted by Lawson as based on work in the Rainy Lake area was questioned by Leith and Lane. Altogether the session was illuminative of the difficulties in the way of any attempt to correlate the Precambrian in widely separated areas.[1]

Other topics considered can only be mentioned in brief. On the physical and faunal characteristics of Palæozoic seas papers were presented by Chamberlin, Schuchert, Ulrich, Frech, and Holtedahl. To the topic of interglacial periods Lamplugh, Coleman, Upham, Alden, Tyrrell, Wolff, and Holst contributed; while at a special session on tectonics papers were given by Paulcke, Dahlblom, Mess, and Smith, McDonald, Howe and Hovey. Numerous miscellaneous papers were also submitted dealing with subjects of geological and mineralogical interest.

During the session of the congress two popular lectures were delivered, to which the Toronto public were invited. The first was by M. Emmanuel de Margerie on the geological map of the world. The lecturer gave some very practical suggestions to the committee in charge of the preparation of the map. He advocated the continental as opposed to the world map, and the discrimination by colour between marine and lacustrine sediments, and between folded and unfolded areas. The continental areas were discussed seriatim, with practical hints as to map-construction. Of more interest to the general public was a lecture by Dr. W. F. Hume on desert phenomena in Egypt. The lecture, which was illustrated by slides, presented a clear picture of the geological conditions, and in particular of the effects of sand erosion on the exposed rocks. Much could be inferred from the slides as to the actual conditions under which work is carried on in desert countries.

Notwithstanding the interest evinced in papers and discussions, the value of the twelfth congress to the visiting delegates lay mainly in the excursions which they were enabled to undertake to many points of geological and mining interest throughout the Dominion. Elaborate preparations had been made by the Geological Survey of Canada to ensure the success of this feature of the meeting, and the total length of line covered by the guide books considerably exceeded 20,000 miles. From July 13 to September 23 excursions practically without a break were arranged for —frequently three, or even more, concurrently. The maritime provinces were visited, before the session, under the guidance of Dr. G. A. Young; Sudbury, Cobalt, and Porcupine before and after the session, the excursions being led by Dr. W. G. Miller; while two transcontinental excursions, the first of more particular interest to petrologists and stratigraphers, the second to economic geologists and mining engineers, had as leaders Dr. Adams and Mr. Brock respectively. An excursion of particular interest, of which many would have gladly availed themselves had time permitted, was that to the Yukon and Alaska boundary, led by Mr. McConnell. Besides these longer excursions numerous field-trips were made, both before and during the session in Toronto. To the localities in the vicinity of Toronto Dr. Coleman and Dr. Parks acted as guides.

For the excursions a series of guide-books was prepared by the Geological Survey of Canada, which contained besides the reading matter numerous coloured maps, topographical maps, and photographs. Apart from the immediate value to the members of the congress, the guide-books represent an important contribution to Canadian geology. They summarise a large amount of investigation accessible only in the reports of the survey, and contribute as well a considerable proportion of new material. They cover the main routes of travel, and will prove valuable books of reference, not only to geologists and engineers, but also to any travellers who may be interested in the resources and rock formations of the country. The interest which the excursions had aroused in Canadian geology was shown by the eagerness with which the literature supplied by the Geological Survey and mines branches was sought after. From this point of view the con-

[1] The discussion had at least one permanent result. A resolution proposed by Dr. Sederholm was passed by the Congress to the effect that geological surveys of countries which have contiguous areas of Precambrian rocks form international committees to include representatives of the geological surveys of all the countries concerned, for the purpose of correlating the Precambrian formations in the different countries.

gress has served as an excellent distributing agency for the literature on the geology and mineral resources of the Dominion.

While the delegates were in Ottawa occasion was taken to do honour to the memory of the first director of the Geological Survey of Canada. Affixed to a block of Laurentian rock, in which formation Sir William Logan did pioneer work, a tablet has been placed in the Victoria Memorial Museum. The tablet, which was unveiled in the presence of the visiting delegates, bears the following inscription:—"William Logan, K.T., LL.D., F.R.S., 1798–1875, the Father of Canadian Geology, Founder and First Director Geological Survey of Canada, 1842–1869. Erected by the International Geological Congress (Canada), 1913." Two of the Canadian universities took advantage of the opportunity afforded them to honour some of the visiting members of the congress. On August 1, McGill University conferred the degree of LL.D. on J. F. Kemp, U.S.A.; H. Bäckström, Sweden; A. Lacroix, France; A. Bergent, Germany; and A. Harker, England. On August 14, the last day of the congress, the University of Toronto paid a similar honour to P. M. Termier, France; T. C. Chamberlin, U.S.A.; R. Beck, Germany; J. J. Sederholm, Finland; T. Tschermyschev, Russia; A. Strahan, England; and W. G. Miller, Canada. A ceremony very different in character—though no less dignified—was performed when the delegates visited Montreal. At the old Indian reservation of Caughnawga the visitors were treated to a short exhibition of the Indian national game, to an Indian play depicting the courtship of former times, and finally four of the party were selected to become chiefs of the tribe. They were:—I. P. Tolmatchew, Russia; W. Paulcke, Germany; H. M. Cadell, Scotland; and F. D. Adams, Canada. After going through the dance of adoption they were given Indian names, and were received as full members of the tribe.

No account of the twelfth congress would be complete without reference to the kindnesses showered on the delegates during their visit to Toronto. The local committee and ladies' committee, aided by the executive committee of the congress, had made very extensive and thorough arrangements, and the people of Toronto responded in a most whole-hearted manner. Receptions, banquets, garden-parties, and afternoon teas were prominent features in the proceedings; automobiles were at the disposal of the members; and several of the clubs in town were thrown open while the congress was in session. If one may judge from the appreciative remarks to be heard on every side, the visiting delegates carried away with them very pleasant memories of Toronto and its people.

On the invitation of M. A. Renier, who represented the Government of Belgium, it was decided to hold the thirteenth congress in Belgium four years hence. The subject on which a special monograph shall be issued by the executive committee of the congress of 1917 was left to the discretion of the new committee. R. C. W.

THE OIL-FIELDS OF BURMA.[1]

THE appearance of this memoir will be welcomed equally by those who are engaged in the study of petroleum from a purely scientific point of view, and by those who are merely concerned with its profitable exploitation in Burma and other parts of the Indian Empire; not only because the author possesses a special knowledge of the subject in both aspects, but also because he has brought together, and arranged in a concise and readable manner, a mass of information that has hitherto been scattered through the pages of a voluminous literature, not always readily accessible.

For close upon a century after Michael Symes and Hiram Cox, in the course of their journeys up the "Erai-Wuddey" to the court of Ava, had visited the earth-oil wells of "Yanangheoum," the great oil-belt of Burma remained almost unexplored by Europeans. The virtues of "Rangoon oil" as a lubricant, especially for small arms, became well known; and following on Dr. Christison's discovery, in 1836, that it contained a large proportion of solid paraffin, considerable quantities of the crude oil were imported into this country for the manufacture of candles. But no further developments took place until, within a year of the annexation of Upper Burma, in 1886, exploitation on modern lines began to supersede the antiquated methods of the Burmese, and a systematic investigation of the conditions under which the oil occurred was taken in hand.

As a result of these investigations, carried on not only by officers of the Geological Survey, but also by geologists employed by the several oil companies, it has become apparent that the petroleum is practically confined to certain horizons—whether one or more has not yet been definitely ascertained—in the upper portion of the enormous accumulation of clays and incoherent sandstones known as the Pegu system, corresponding fairly closely with the Miocene of Europe. These beds, according to Mr. Pascoe, were deposited in a great gulf some 400 miles in length, occupying the greater portion of the present Irrawaddy valley. Orogenic folding, proceeding, in part, simultaneously with the deposition of the beds, has thrown them into a series of elongated domes, beneath which the oil has accumulated. The second and third parts of the memoir are devoted to a discussion of the structure of each of the anticlines so far examined, and of its capabilities as a producer of oil.

The most productive of these anticlines as yet discovered is that of Yenangyaung, where Dr. Oldham first recognised, in 1855, the connection between anticlinal structure and the accumulation of petroleum. Here the oil is confined within an area of less than one-and-a-half square miles, and yet, since the year 1888, this little field has produced more than a thousand million gallons. Nothing like this has been discovered elsewhere in

[1] "The Oil-fields of Burma." By E. H. Pascoe. Pp. xxxix+269+54 plates. Memoirs of the Geological Survey of India. (Calcutta: Geological Survey; London: Kegan Paul, Trench, Trübner and Co., Ltd., 1912.) Price 6s. 8d.

Burma, though many an anticline, apparently as well fitted for the storage of petroleum, has been examined and tested. Meanwhile no fewer than nine companies are engaged in a race for the deeper and richer oil-sands in the Yenangyaung field, and it would appear that the end cannot be far off. One may, perhaps, be allowed to express regret that steps were not taken by Government to regulate this competition until it had seriously affected the resources of the field; especially in view of the fact that Burma is the only country directly under Imperial control which is known to possess large stores of petroleum, and that an adequate supply of fuel oil may become, in the near future, of vital importance to the national existence.

Yenangyaung—Native well-digger in diving dress. (The man on his right is holding the mirror used to illuminate the bottom of the well.) From Memoirs of the Geological Survey of India, vol. xl., part i., "The Oil-fields of Burma."

In the final chapters of the work will be found an able discussion of the origin of petroleum, and of its relations to geotectonic structure. The difficulty of accounting for the presence of oil-sands above a water-bearing stratum (a by no means uncommon occurrence at Yenangyaung) on any theory of inorganic origin, which would entail an upward migration of the oil from a deep-seated source, seems to be insuperable; while, on the other hand, the arguments brought forward in favour of an organic origin, at least in Burma, Assam, and other similar areas, seem no less convincing. Though any direct genetic relation between coal and oil is expressly disclaimed, their close juxtaposition in those countries is highly suggestive, as well as the affinity shown to exist between petroleum gas and such admittedly organic products as marsh-gas and firedamp, in respect of the proportion of methane that they contain. The solution of the problem is one of great practical importance, for upon it depends the question whether an oil-sand, once drained of its petroleum, might ever recover its productiveness.

T. H. D. L.

OCEANOGRAPHY OF THE MEDITERRANEAN.[1]

THE Mediterranean Sea has always been an attractive field for oceanographical investigation, since it presents many features which contrast strongly with those of the other enclosed seas. Italy, Sicily, and a submarine ridge over which the greatest depth of water is about 400 metres, separate the whole area into two sea-basins. The western one, comprising the Balearic and Tyrrhenian Seas, is, for the most part, about 2000–3000 metres in depth; while the eastern basin, which includes all the seas to the east of Italy and Sicily, is rather deeper on the average, and soundings of more than 4000 metres have been made. Large coastal areas, like the North Sea, with depths of less than 200 metres do not

[1] Report on the Danish Oceanographical Expeditions of 1908–10 to the Mediterranean and Adjacent Seas. Edited by Joh. Schmidt. Vol. i., Introduction, Hydrography, and Sen-bottom Deposits. (Copenhagen, 1912.) Pp. 270+xx plates.

exist, and because of this absence of extensive tracts of sea-bottom of moderate depth, fisheries on the scale of those of the North Atlantic enclosed seas are non-existent. Because of this relative unimportance of the sea-fisheries, the fauna of the Mediterranean is not nearly so well known as, for instance, that of the North Sea and Baltic; and the remainder of the reports of the Danish expeditions, dealing with the biological investigations, promise to be of exceptional interest on this account.

The sea-bottom deposits are of relatively little interest. Over by far the greater part of the Mediterranean the bottom is covered by terrigenous materials. These contain far less volcanic débris than might have been suspected. Siliceous materials are also relatively rare, and the chief calcareous deposits are to be found over relatively small areas, and contain Pteropod shells.

The hydrographic conditions in the Mediterranean depend mainly on the fact that this water area is one of high concentration. The amount of water received from the rainfall over the land area which it drains is far less (less than a quarter, it is said) than the amount of water removed by evaporation. The temperature of the superficial strata of water is relatively high: even at a depth of 1000 metres it is uniformly 13° C., while the salinity is also relatively high, being everywhere about 38 per mille in the bottom and intermediate strata. This excess of evaporation over precipitation would lead, of course, to a reduction of water-level, were it not compensated by the strong inflow from the Atlantic through the Straits of Gibraltar. But this inflow tends, of course, to raise the hydrostatic pressure of the water in the sea, and therefore a counter-current sets out from the Mediterranean into the open Atlantic Ocean. The inflowing current is superficial, has a velocity of from one to three knots, a temperature which is that of the Atlantic water in the Spanish Bay, and a salinity of about 36 per mille. The outflowing current is a deep one, its velocity varies from one-half to about five knots, its temperature is uniformly about 13° C., and its salinity is about 38 per mille. The variations in velocity are due to the tidal streams in the straits.

The volume of relatively warm and dense water flowing out from the Mediterranean is very considerable. This water is so highly saline that it flows on as a bottom or intermediate current in spite of its high temperature. Although its direction is nearly east to west as it emerges from the straits, it soon becomes deflected to the north and east as the result of the earth's rotation, and it approaches the coasts of the British Islands. Normally it flows to the west of Ireland, and Dickson has shown that it may be present even so far north as the channel between Rockall and Scotland, but as a rule the current must flow along deep depressions of the sea-bottom. If, however, it is unusually strong it may enter the shallower sea-basins, and Bassett has recently suggested that unusually high salinities in such enclosed sea areas as the English Channel or Irish Sea may be due, not to an unusually strong Gulf Stream drift, but more probably to the presence of this highly saline Mediterranean water. This indeed, appears to have been the case in the summer of 1912 in the Irish Sea and adjacent waters.

Precisely the opposite conditions exist in relation to the Black Sea and the Sea of Marmora. The latter basin has a depth of 1000 to 2000 metres, and the Black Sea has a maximum depth of about 2200 metres. The Black Sea is an area of excess of precipitation over evaporation, so that the superficial strata of water are of low salinity. From the surface down to about 20 metres the salinity is about 17·5 per mille, and it is nearly constant at this limiting depth, increasing towards the bottom. The temperature appears to be nearly constant at about 80 metres depth, and also increases slightly towards the bottom. Because of the excess of precipitation over evaporation the water-level of the Black Sea tends to rise, but this is prevented, of course, by an outflow of relatively light water through the Bosporus into the Sea of Marmora, and from the latter basin through the Dardanelles into the Mediterranean. But since this outflow reduces the hydrostatic pressure of the communicating water masses, a counter-current of relatively dense Mediterranean water enters the Sea of Marmora, and then the Black Sea through the Bosporus. The water flowing out from the Black Sea is a surface current, that flowing in a deep one. The depth of water at the entrance to the Black Sea is, however, very small, and the existence of this "sill" prevents the complete renewal or ventilation of the deeper strata of water, a condition which also exists, on a much smaller scale, in some of the Norwegian fjords. The absence of renewal of water leads to the stagnation of most of the water of the Black Sea: not only is oxygen absent in the deeper layers, but its place is actually taken by sulphuretted hydrogen, and except for some forms of bacteria this water-mass is lifeless.

The horizontal water circulation in the Mediterranean depends on the Atlantic inflow. This is at first west to east in direction, but, becoming deflected to the right in consequence of the rotation of the earth, it flows along the coast of Africa. The direction of flow of surface-water then follows the general scheme of that in the northern hemisphere. Two cyclonic circulations are set up in the western basin—one in the Balearic Sea to the west of Sardinia and Corsica, and another in the Tyrrhenian Sea. The main stream enters the eastern basin through the channel between Sicily and Tunis, and then becomes deflected, forming another cyclonic circulation. There is also an intermediate level water circulation which depends for its direction on a complex resultant of superficial horizontal circulation and vertical circulations due to concentration and cooling of superficial waters. This intermediate circulation is difficult to explain, and, indeed, is still imperfectly known. It is, of course, the origin of the westerly flowing deep current in the straits, and seems to result from the junction of two main streams flowing to the south of Sardinia and the north of Corsica respectively.

Many disputed questions are discussed by the authors of the papers in this report, and we await with interest the results of the biological investigations. There is no doubt that the fishes and other groups of animals inhabiting the Mediterranean area are still imperfectly known; while the investigation of the pelagic microscopic life of these seas is one which is full of interest. A good deal of such work has, of course, already been done, but the results of investigators thoroughly familiar with deep-sea work of this kind in the northern seas are sure to be interesting, and the comparisons which we may expect they will attempt ought to throw new light on many questions of general biological interest. J. J.

THE GUM TREES OF AUSTRALIA.[1]

MR. T. H. MAIDEN, the director of the Botanic Gardens, Sydney, N.S.W., published the first part of his great work on the characteristic Australian genus Eucalyptus in 1903, and it has now reached the seventeenth part. There is no other country of the same extent as Australia in which one genus of trees largely predominates throughout and, at the same time, has few extensions beyond. It has been estimated that three-fourths of the forest vegetation of Australia consists of gum trees and bushes, yet the genus is not represented in the native flora of New Zealand, New Caledonia, Lord Howe Island, and other contiguous countries, including, I believe, New Guinea, though *E. alba* is a native of Timor.

But, like Baeckia and Melaleuca, other myrtaceous genera, Eucalyptus has a considerable northward extension in eastern Asia, limited, however, to one species the present distribution of which is peculiar. Mr. Maiden has succeeded in showing that this species, *E. naudiniana,* abundant in Neu Pommern (New Britain), is the same as that discovered in Mindanao, Philippines, by the United States Exploring Expedition (1838–42), and described under the name multiflora—a name previously occupied. These two localities are separated by about 13° of latitude and 25° of longitude, or, approximately, 1500 miles, and hitherto *E. naudiniana* has not been recorded from any intermediate locality. Its presence in the Philippines is an interesting fact in phytogeography, and the question arises, Is it a straggler of a southern migration, or is it, and similar outliers, a northward extension of a type of southern origin? But this is not the place to discuss the point.

So far Mr. Maiden has described and figured ninety-four species of Eucalyptus, and given all details available of their distribution, based on practically all the important herbarium material in existence, and a very wide personal experience in the forests of all parts of the country. Upwards of one-third of these ninety-four species are of later date than Bentham's "Flora Australiensis," or were not given specific rank by Bentham. From a rough calculation the number of valid species of Eucalyptus will not be fewer than 150; some generally dispersed, though the western species are mostly different from the eastern, and many of them bear more conspicuous flowers than the eastern. Others are very rare and near extinction, notably the very large-flowered, shrubby *E. macrocarpa.* It is to be hoped that Mr. Maiden's health and official duties will permit him to bring this valuable monograph to a relatively early conclusion, as it is only in the complete form that it can be fully useful.

W. BOTTING HEMSLEY.

[1] "A Critical Revision of the Genus Eucalyptus." By J. H. Maiden, Government Botanist of New South Wales. Parts xii–xvii. Plates 50–76. with descriptive letterpress. (Published by Authority of the Government of the State of New South Wales, 1910–13.) Price 2s. 6d. each part.

NOTES.

WE are informed by Dr. H. Mohn that he has resigned the professorship of meteorology in the University of Christiania and the directorship of the Meteorological Institute of Norway. Mr. Aksel S. Steen has been appointed to succeed him in these positions.

AT the time of going to press with our issue of last week, the race by Mr. H. G. Hawker in an all-British waterplane for the 5000*l.* prize offered by *The Daily Mail* was in progress. The distance to be covered was 1540 miles, and of this 1043 had been accomplished on Wednesday when, according to the aviator, his foot slipping off the rudder bar, he lost control of the machine, which fell into the water of Lough Shinny, Ireland, and was wrecked. Mr. Hawker and his companion, Mr. Kauper, were rescued, the first-named uninjured, but the latter with a broken arm and other injuries. Although the task set him to accomplish was not fulfilled, the aviator must be congratulated upon having made a very satisfactory series of flights. The machine, fitted with a Green engine, was built by the Sopwith Aviation Company, and was a biplane with a span between the wing tips of 50 ft., and a length of 31 ft. 6 in. It had two main floats, with single hydroplane step, each weighing 170 lb., and also a small torpedo float under the tail. The total weight of the machine and passengers was estimated at 2400 lb.

THE next International Conference on Cancer (the fourth) is to be held at Copenhagen in 1916.

ACCORDING to the *New York Medical Journal,* an International Exposition of Safety and Sanitation will take place in New York in December next. It will include exhibits devoted to safety, health, sanitation, the prevention of accidents, the welfare of the public and the individual, and the advancement of the science of industry. Exhibits from foreign countries will, by a special Act of Congress, be admitted free of duty.

A REPORT from Vienna states that a ship has been purchased for an Austrian expedition to the South Polar regions, and that funds are being collected in aid of the object. The expedition is to be under the leadership of Dr. F. König, of Graz, and the proposal is that it shall leave Trieste in May next. A large donation to the funds has been given by the Austrian Academy of Science, and the Austrian Geographical Society has promised an annual subsidy towards the cost of the undertaking.

Mr. D. A. Bannerman has returned from a zoological mission to the eastern islands of the Canary group, undertaken with the object of procuring examples of the birds of these islands for the Natural History Museum. The islands visited were Fuerteventura, Lanzarote, Graciosa, Montana Clara, Roque de l'Oueste, and Alegranza, several of which had not previously been visited by a collector. Mr. Bannerman succeeded in obtaining a number of rare and interesting species peculiar to the islands, while the fact that the birds were collected in their breeding plumage renders them of special value to the museum bird room. On Alegranza a new species of chat was discovered.

Reference was made in our last issue to the three educational museums which were founded and equipped by the late Sir Jonathan Hutchinson. We regret to learn from *The Times* that the future of these institutions is in an uncertain state and causing anxiety to those who have been privileged to make use of them. So far as the museum of Haslemere is concerned, there is a strong feeling in the town that everything should be done to retain the institution, and it is understood that the family are willing to hand it over to a responsible committee or body of trustees so that the museum may be placed on a permanent and public basis. The annual cost of maintenance on the present lines is about 400*l*., and an appeal will shortly be issued with the hope of securing this sum for five years at least, it being thought that by that time those who are interested in the matter will have had an opportunity of deciding what are the best steps to be taken for the permanent control and maintenance of the museum.

As was stated in our issue of July 3 last, plans are being prepared for the new buildings to be erected at the Rothamsted experiment station in commemoration of the centenary of the birth of Sir John Lawes and Sir Henry Gilbert. We now learn from the *Journal* of the Royal Society of Arts that strong committees are being formed to raise the necessary funds for the memorial. It is stated that the sum of 12,000*l*. is required, and of this amount half will have to be raised by public subscription, the remaining half being obtainable from the development fund.

A tablet was unveiled on Sunday last at Primiero, Southern Tyrol, on the house in which Alois Negrelli was born, to commemorate Negrelli's work as surveyor of the Suez Canal. He began his investigations in 1847, completed his plans in 1855–6, and in 1858 was appointed inspector-general of the Suez Canal works. He died on October 1 of the latter year.

We note, with regret, the death, at the age of sixty-six, from typhoid fever, while on his voyage home from the Philippines, of Dr. Tempest Anderson, who for a time lectured on volcanoes at the Royal Institution. He was joint author of the report to the Royal Society on the seismic disturbances in the West Indies in 1902 and 1907, and had filled, among other positions, those of president of the Yorkshire Philosophical Society and the Museums Association.

The death is announced, at the age of sixty-six, of Col. Andrew Clark, a gold medallist of the British Medical Association, lecturer on surgery at the Middlesex Hospital Medical School, and author of the "Middlesex Hospital Surgical Reports, 1872–4," and of "Ambulance Lectures." He also edited the fourth edition of "Fairlie Clark's Manual of Surgery."

It is stated in *The Allahabad Pioneer Mail* that the Maharaja Scindia of Gwalior is giving special attention to the valuable archæological relics and treasures in his State, and is taking steps to create an archæological department in Gwalior. In furtherance of this object he has sought the advice and cooperation of the Director-General of Archæology in India.

According to *The Scientific American*, a large naval radio station is shortly to be constructed by the United States at Caimeto, Panama, to be known as the Darien Radio Station. It will consist of three towers, each 600 ft. in height. The bases of the towers will be 180 ft. above sea-level, and they will be arranged in a triangle measuring 900 ft. on each side. The sending and receiving radius will be about 3000 miles direct reach to the Arlington Station, to San Francisco, and to Valdivia, 420 miles south of Valparaiso, on the Pacific, and Buenos Aires on the Atlantic. It will cover a vessel anywhere on the east coast of the United States, and communicate with St. Vincent. The system to be used is the Poulsen.

New lightning conductors have been installed on St. Paul's Cathedral. In the course of the operations part of one of the original iron bar conductors erected more than 140 years ago under the supervision of Benjamin Franklin was discovered. This bar, having been inside one of the towers and so not exposed to the weather, was still in a good state of preservation. *The Times* recalls that the fixing of these "Franklin rods," as they were called, led to a heated controversy as to whether lightning conductors should have points or balls as terminals. The president of the Royal Society, who advocated points, had to resign. King George III. was a strong adherent to ball terminals.

It is announced in *The Times* that a discovery of oil shale has been made in the island of Skye by Dr. G. W. Lee, a member of the scientific staff of the Scottish Geological Survey and Museum, Edinburgh, who was examining the geological structure of the east coast of Skye. The extent and value of the deposits are not yet fully known, but it is stated that the seam discovered is about 11 ft. in thickness, that it extends over a considerable area, and that, although not of first-class quality or so good as the seams worked in the Lothians, it is likely to prove sufficiently good to be worked successfully, in view of the improved methods of operation now followed by the leading shale oil firms.

THE droughty summer has closed with some exceptionally heavy rainfalls over the south-eastern portion of England, where the rains for the last two or three days of August have materially modified the aggregate measurements for the season. At Greenwich the rainfall for the three days, August 29 to 31, was 1·22 in., which is more than the total for the preceding part of the month. Without the rainfall for the last three days of summer the total for the three months at Greenwich would have been more than an inch less than for the corresponding season in the abnormally fine year 1911. The total rainfall for the summer at Greenwich is 4·69 in., whilst in 1912 it was 7·86 in., and in 1911 it was 3·72 in. The driest summer of the last seventy years occurred in 1864 with 2·50 in., and in the last fifty years there have been fourteen summers drier than the one which has just closed. At Greenwich the summer rains this year are 70 per cent. of the average. In places the recent rains have not had much influence on the total for the summer. At Jersey the summer rains, June, July, and August, are only 28 per cent. of the average; at Leith, 40 per cent., where until August 28 they were only 28 per cent.; at Valencia, 51 per cent.; and at Liverpool, 66 per cent. The mean temperature for the three months at Greenwich was 61°, which is in precise agreement with 1912, and 5° cooler than 1911. The sunshine this summer was 442 hours, in 1912 it was 497 hours, and in 1911 it was 819 hours.

THE proceedings of the third meeting of the General Malarial Committee of the Government of India, held at Madras during November, 1912, have been published recently as a substantial volume, which contains much interesting reading and affords evidence of a great deal of energetic and enthusiastic research upon the etiology of disease in India. The papers and discussions reported cover a wider field than the title indicates. Several papers deal with the question of *Stegomyia fasciata*, the mosquito known to be the carrier of yellow fever in the New World; in view of the approaching opening of the Panama Canal, when the endemic home of yellow fever will be brought into closer communication with the Far East than it is at present, the degree of prevalence of this mosquito in the ports of India is likely to become a matter of urgent practical sanitary importance. Other papers read dealt with the vexed question of the transmission of Kala Azar. Capt. Patton, who regards the parasite causing this disease as a member of a group of Flagellates primarily parasitic in insects, has observed developmental stages of the parasite in the common bed-bug, but as yet no satisfactory experimental proof that the bed-bug transmits Kala Azar has been brought forward, nor has the existence of any "reservoir" of the disease in domestic or wild animals be demonstrated. The problem of Kala Azar is, however, under investigation by a number of competent workers, and its solution in the near future may be confidently expected.

THE Australian Institute of Tropical Medicine has issued its report for the year 1911 (more correctly for the year ending March, 1912). The bulk of the report is written by the director, Dr. Anton Breinl, and contains important investigations dealing chiefly with parasitic worms and Protozoa, illustrated by eleven excellent lithographed plates. Especially noteworthy amongst these researches is an investigation into the morphology and life-history of *Onchocerca gibsoni*, the nematode parasite which causes the so-called worm-nodules in Australian cattle. A number of experiments were recorded which were directed towards solving the problem of the transmission of this parasite, but up to the present these experiments have not led to any conclusive results as to the intermediary host of the worm. Appended to the director's report is that of the entomologist, Mr. Frank H. Taylor, and a report on the Cestoda and Acanthocephala of North Queensland, by Dr. T. Harvey Johnston. The entire report makes a quarto volume of 96 pp. and 17 plates, neatly bound in cloth, but having one defect from the point of view of the bibliographer, namely, that there is nowhere any indication to be found of the date of publication, whether 1912 or 1913. This is an unfortunate omission in a work which describes numerous new species of animals, including even a new species of Cyclops.

IN a recent number of the Annals of Tropical Medicine and Parasitology (vol. vii., No. 3A), Dr. J. W. Scott Macfie gives an account of a new species of trypanosome observed in human beings in Nigeria. It occurs most commonly in young people, and produces a mild form of sleeping sickness in which the trypanosomes cannot be found in the peripheral blood, but are present in the lymphatic glands. To the smaller experimental animals of the laboratory the trypanosome appears to be but slightly pathogenic. In the blood of the guinea-pig the trypanosome is smaller than *Trypanosoma gambiense;* like that species it is polymorphic, with long and slender, short and stumpy, and intermediate forms, and a few minute trypanosomes, measuring as little as 8 μ in length, appear constantly in the blood-films. Some of the short, stumpy forms have the principal nucleus situated far forwards at the anterior (flagellar) end of the body. Forms in which the flagellum appears to be free from the body for its whole length are also found. The Nigerian trypanosome is regarded by Dr. Macfie as a species distinct from *T. gambiense*, and is given the name *T. nigeriense*.

IN part 6, vol. iii., of the Journal of the East Africa and Uganda Natural History Society, Mr. C. W. Hobley discusses, from an examination of weapons used by the Pygmy and other neighbouring tribes, the question of the evolution of the arrow. He comes to the conclusion that the use of the stone point is later than that of the thorn; hence, that the use of poison applied to the tip is probably older than is commonly supposed; the lateral barbs were suggested by some of the many thorny-stemmed plants which flourish in the bush in which the hunter lived. He suggests that the aboriginal tribes of the centre of the continent passed direct from the use of natural thorns to the use of iron points, but the people east of Lake Victoria began with natural thorn points, passed through an age in which stone arrow-points were used, and eventually passed into an iron age, the variation in development depending on the absence or presence of suitable stone for making arrow-points. The wooden point still survives, but only sporadically; the stone point has disappeared, but the leaf-shaped iron point used by some of the Kavirondo, Nandi, and also found among the Tharaka, is undoubtedly a copy of the leaf-shaped stone arrow-head, of which good examples are now coming to light.

THE possibility of the existence of some hitherto unidentified animals in Central Africa is again raised in a communication by Mr. C. W. Hobley, published in part 6, vol. iii., of the Journal of the East Africa and Uganda Natural History Society. One of them is described as possessing "thick, reddish-brown hair, with a slight streak of white down the hindquarters, rather long from hock to foot, rather bigger than a hyena, with largish ears." Some naturalists are inclined to identify it with the hairy ant-bear, Orycteropus; but most of those who have seen it are well acquainted with the ant-bear, and it is an almost unique phenomenon for an ant-bear to be seen abroad in daylight. The natives, again, have tales of a lake monster which the Baganda call Lukwata. Europeans have seen a strange beast swimming in the Napoleon Gulf, which was apparently not a crocodile. An American sportsman, E. B. Bronson, saw on the Gori River, Lake Victoria, a beast "14 to 15 feet long, head as big as a lioness but shaped and marked as a leopard, two long white fangs sticking down straight out of his upper jaw, scaled like an armadillo, back broad as a hippo, spotted like a leopard, and a broad, fine tail; the imprints of its feet were as large as that of a hippo but clawed like a reptile." Another monster has been seen by natives "as large as a man, sometimes going on four legs, sometimes on two, in general appearance like a huge baboon, and very fierce." Naturalists will await with interest the discovery of specimens of these strange animals.

BEFORE the publication, in *The Philippine Journal of Science* for April last, of Mr. H. O. Beyer's paper on origin myths among the mountain peoples of the Philippines, no representative collection of Philippine myths had been made. Until recent years it was believed that all ancient records written in the syllabic alphabets which the Filipinos possessed at the time of the Spanish conquest had been lost; but two of these alphabets are now found in use by wild tribes of Palawan and Mindoro, and ancient manuscripts written in the old Bisaya character have recently been discovered in a cave in the island of Negros. These still await publication. Mr. Beyer's paper is based on oral tradition and gives a large collection of interesting legends, including an underground death-land, a story of the Atlas type, in which the world is supported by a post created by the chief deity and near which he dwells, and a remarkable flood myth current among the Central Ifugaos. It may be hoped that Mr. Beyer will continue his researches in the new folklore area.

MR. T. SHEPPARD, curator of the Municipal Museum, Hull, has issued a fourth edition of his catalogue of the collections under his charge. This is rendered necessary by the process of rearrangement which followed important additions to the collections, and the establishment of the new Wilberforce House Museum and the Pickering Museum of Fisheries and Shipping, which has done much to remove the pressure on the original buildings. Wilberforce House, built for the Lister family, about the end of Queen Elizabeth's reign, a beautiful old residence with numerous relics, was the birthplace of the philanthropist, William Wilberforce, born here in 1759, and has now become the repository of collections illustrating his life, and of the general history of Kingston-upon-Hull. The Pickering Museum is largely devoted to collections illustrating the whaling, fishing, and shipping industries, the nucleus being the specimens collected by a public-spirited citizen, Mr. C. Pickering. Hull is to be congratulated on the activity displayed by its municipality and residents on the establishment of these museums, and the curator, Mr. T. Sheppard, on the valuable series of catalogues issued at a nominal price.

DR. W. S. HUNTER'S "The Delayed Reaction in Animals and Children," affords an interesting contribution to the "Behavior Monograph Series." A release box is employed leading to three different compartments, any one of which can be illuminated by the experimenter. The compartment which is illuminated can be opened and entered by the subject, whereas the other compartments are closed. Food is obtained by entering the illuminated compartment. Rats, dogs, raccoons, and children were used as subjects. After a clear association had been established between the movements leading to food and the light which might appear in any one of the three boxes, experiments were begun in which the light was turned off *before* the subject had made the appropriate reaction. The research consisted in determining the maximal length of this delay-period which is compatible with a correct response, and in ascertaining the psychological factors at work permitting of the correct response after the delay-period. The author lays stress on the importance of what he terms "sensory thought."

THE current number of *The Psychological Review* contains an important paper on association and inhibition, by Prof. J. F. Shepard and Mr. H. M. Fogelsonge, based on the learning of nonsense-syllables. In the first series of experiments these were learnt in pairs, and subsequently the subject was tested by being shown the first syllable of a pair either alone or in different combinations. These combinations of first syllables were either shown successively or simultaneously. Where two first syllables were shown successively, the second was shown at such an interval that the association set up by the former was not already completed in the subject. In a second series of experiments, three, instead of two, syllables were learnt together, and, in testing, the first two of the three syllables were shown simultaneously; these might belong to the same or to different three-syllable groups. In other series of experiments two different syllables were each separately learnt in conjunction with one and the same syllable; the two syllables were subsequently presented successively to the subject when tested. The resulting reproduction-times, as measured by the chronoscope, convince the authors that the inhibition or facilitation thus experimentally produced is one "which cannot be . . . explained neurologically as a division of energy, or drainage." They believe that "an association cannot be explained as a mere path of lowered resistance," but that it "involves other processes which prevent any other stimulus from using the same neuroses at the same time . . . and which block any other association that is tending to operate at the same time, even though both will lead to the same end result."

IN vol. viii., Section D, No. 3, of *The Philippine Journal of Science*, Mr. A. E. W. Salt gives an elaborate account of the endowment provided by Francisco de Carriedo y Peredo, the greatest benefactor of the city of Manila, who died in 1743. From the funds received under his will, a water supply was provided for the city until the American occupation. A new system to supplement the ancient supply was opened in 1908. Water is now brought from an almost virgin watershed of one hundred square miles in area, and thence carried to a storage reservoir with a capacity of 210,000,000 gallons. The city, however, is so rapidly developing that this system is barely adequate to the needs of the population. Mr. Salt has done good service in directing attention to the benevolence of a citizen who, at a time when sanitation occupied little public attention, devoted his wealth to this excellent purpose.

IN Professional Paper No. 79 of the United States Geological Survey, Mr. H. S. Williams discusses the recurrent Tropidoleptus zones of the Upper Devonian in New York. In preparing the data for the Watkins Glen-Catatonk folio (No. 169 Geol. Atlas USUS, Geol. Survey, 1909) the occasional discovery of *Tripodolpetus carinatus* (Conrad) in strata far above the supposed range of the species or of the fauna with which the species is normally associated led the writer to undertake an examination of the sections and sequence of fauna where they appeared. The result throws important light upon the regional geography. The departure and return of the fauna must have been due to diastrophic changes which produced recurring favourable or unfavourable conditions for the existence of the fauna. Those changes of conditions may have resulted from the alternate closing and reopening of an actual passage-way which obstructed or admitted the access of the fauna and of waters favourable to them, or from changes that affected the direction, character, or volume of the existing ocean currents.

THE insect food of Canadian fresh-water fishes forms the subject of an article by Dr. Gordon Hewitt, the Dominion entomologist, published in the fourth annual report of the Commision of [Fish] Conservation of Ottawa. Attention is directed by the author to the futility of attempting to restock depleted rivers, or to introduce new kinds of fish into Canadian rivers, without taking measures to ensure an abundant supply of suitable insect food. In Europe it has been demonstrated that the artificial cultivation of many kinds of insects constituting the chief food of fishes is perfectly practicable; and in many rivers an insect hatchery is almost as necessary and important as a fish-hatchery. Before such insectaria can be introduced with satisfactory results in Canada, a close investigation into the nature of the food of native or introduced fishes is absolutely essential.

A RECENT number of the *Zeitschrift für wissenschaftliche Zoologie* (Bd. cv., Heft 3) is entirely devoted to a memoir on the chemical composition of the hæmolymph of insects and its significance as regards sexual differentiation. According to the author, Herr Kurt Geyer, the hæmolymph in caterpillars and pupæ of Lepidoptera is usually green in females and pale yellow or colourless in males. The green pigment is, as Poulton has already shown, slightly altered chlorophyll in solution, derived from the food-plant; it constitutes a protective coloration, and it is improbable that it has any assimilatory function. The yellow colour of the male hæmolymph is due to the yellow constituents of chlorophyll (xanthophyll). The hæmolymph of non-phytophagous insects shows no such colour difference. When the male and female hæmolymph are mixed a heavy precipitate is at once formed, and this reaction can only be distinguished quantitatively from that which takes place between different species. The author concludes that in insects the entire soma is sexually differentiated in male and female.

DR. C. H. OSTENFELD'S account of the biology and distribution of the phytoplankton of Danish seas (De Danske Farvandes Plankton i aarene 1898–1901. Phytoplankton og Protozoer. D. Kgl. Danske, Vidensk. Selsk. Skrifter. 7. Raekke, Naturvidensk og Mathem. Afd. ix. 2. 1913) is of more than local interest. The main work is written in the Danish language, but there is a *résumé* in French, extending to 65 pp., which in itself constitutes one of the best summary accounts which we possess of the present state of our knowledge of the general problems of the biology of plankton organisms. The Danish seas, extending as they do from the Baltic through the deep waters of the Skager Rak to the North Sea, furnish such wide variations in salinity, temperature, and chemical constitution, that they offer exceptional opportunities for studying the effects of physical conditions on the distribution of the plankton, and this aspect of the subject receives a full consideration in the report. A good bibliography will be found on pp. 346–352.

FROM the Kommissionen for Havundersögelser in Copenhagen we have received three further reports dealing with the investigations which have been carried out under the direction of Dr. Johs. Schmidt into the life-histories of eels. These are: Danish researches in the Atlantic and Mediterranean on the life-history of the freshwater-eel (*Anguilla vulgaris*, Turt.), with notes on other species, by Johs. Schmidt (*Internat. Revue Hydrobiologie und Hydrographie*, 1912); on the identification of murænoid larvæ in their early (preleptocephaline) stages, by Johs. Schmidt (*Meddel. Komm. Havunders. Fiskeri Bd.* iv. 2); and the metamorphosis of elvers as influenced by outward conditions—some experiments, by A. Strubberg (*Meddel. Komm. Havunders. Fiskeri Bd.* iv. 3). In NATURE, vol. lxxxix., pp. 633–636, Dr. Schmidt himself gave a brief account of these researches, and those interested in the subject will no doubt welcome the more detailed reports.

In his presidential address to the Quekett Microscopical Club for this year, Prof. Dendy dealt with the subject of "By-products of Evolution," illustrating his theme by the spicules, more particularly the microscleres of siliceous sponges. After pointing out that these minute spicules exhibit constant specific characters, and have undoubtedly arisen by some process of evolution, since one form leads on to another, just as in the case of any other characters, it is argued that natural selection cannot be directly responsible for their origin, on the ground that the minute differences in the form of the microscleres cannot be of any importance to the sponge in the soft tissues of which they are scattered without order or arrangement. By the principle of correlation non-adaptive characters of this kind may be linked inseparably with other characters which being adaptive, are directly influenced by natural selection, in such a way that any variation in the one must be accompanied by a corresponding variation in the other. Thus, a non-adaptive character may undergo a progressive evolution indirectly controlled by the action of natural selection. The principle of correlation cannot, however, be invoked to explain the specific forms assumed by the microscleres; it can only help to explain why such characters exist at all and why they should undergo progressive evolution. The specific form of the microsclere must be produced by chemical and physical causes involved in, and controlled by, the hereditary constitution of the mother-cell.

Sir F. W. Moore contributes a useful paper on hardy water-lilies to *Irish Gardening* (vol. viii. May, 1913), including not merely cultural hints and lists of species suitable for ponds of different depths, but also some interesting remarks on the general biology and mode of growth of these plants. For instance, the author lays stress on the importance of the study of roots to the gardener; observation of water-lilies shows that from early April to June new roots are developed rapidly as the new leaves and flower-buds are formed and the rhizome elongates, while the older roots largely die away after having served as collectors of food reserves during previous years and as anchors during the winter. It is also noted that while, as a rule, the flowers close on bright days between three and four o'clock in the afternoon, if after noon the day becomes wet and gloomy the flowers usually remain open until dark.

In continuation of his investigations into "Southern Hemisphere Seasonal Correlations" (Nature, August 7), Mr. R. C. Mossman contributed a fourth article to *Symons's Meteorological Magazine* for August. He pointed out an interesting instance of the temporary character of many correlations. The example chosen was the comparison of April to September rainfall at Trinidad (West Indies) with that at Azo (Argentine Republic) for the following six months. Dealing with the fifty years, 1862–1911, it was found that from 1862 to 1877 and from 1895 to 1911 there was no relation between the rainfall of the six-monthly periods; but during the seventeen years 1878–94 the curves showing the rainfall departure from normal are the reverse of each other. The author observes that these results are of importance, as they show that the physical processes that produced a given precipitation at Trinidad during the period under discussion were associated during the six months following by an opposite effect in the south temperate zone, some 2850 geographical miles distant. Mr. Mossman also refers to one or two interesting correlations in other regions, especially one between the rainfall of Java and Trinidad.

The Meteorological Office chart of the North Atlantic and Mediterranean for September (first issue) shows that the last report from the scout-ship *Scotia* was dated August 7 in 54° 45′ N., 49° 30′ W.; no ice in sight. It is pointed out that the full scope and value of the work accomplished cannot be estimated until the reports of the captain and scientific staff have been submitted. The ice notices which may prove to have been of most value are those relating to the comparatively small quantities that have been seen drifting south in the polar current. An important feature this year is the fact that the ice has been held up, for the most part, north of latitude 43°. The special reports above mentioned will, it is thought, no doubt decide whether this was due to abnormal strength of the Gulf Stream, to unusual weakness of the Labrador current, or to both causes.

A circular headed "Road Dangers" has been widely circulated by the editor of *The Automotor Journal*. It suggests that the dangers both of vehicular and foot-passenger traffic might be greatly minimised if at crossings the traffic of one street were arbitrarily given a right of way and the traffic of the other street which crosses it were made to go dead slow by a sign that must be obeyed. The writer of the circular considers that not only would the accidents that occur from collisions of vehicles at crossings be greatly reduced, but the noisy use of the horn would be no longer necessary. It is difficult to see how the suggestion can be carried out without some enactment giving to a street authority a power to make bye-laws controlling the traffic in the less important streets and which can be enforced by the police. It would be easy for the Chief Commissioner, through his advisers in Scotland Yard, to decide which streets are to be of primary and which are to be of secondary importance, but short of keeping a constable on traffic duty at every crossing it is difficult to see how, with his existing powers, he can instruct them to summon drivers disobeying notices informing them that they must give way to traffic in the preferred streets.

We have received a copy of the third edition of Merck's "Reagenzien-Verzeichnis." It is a volume of 446 pages, and all the commoner reagents, tests, hardening and preservative fluids, and the like are given alphabetically under authors' names, some 5000 formulæ being thus detailed, with references to the literature. There is further a valuable list of the substances for which the tests are employed, and a similar one for those used in microscopic work. Finally, there is an index of the preparations employed for the various tests, with authors' names attached; thus we find that "arbutin" was recommended by Reichard as a test for nitric acid. The lists are most complete, and so far as we have been able to refer to them are accurate, and are not confined to recent work; *e.g.* Beale's carmine stain and injection fluids are given. The volume will be of the greatest service in the chemical and the biological laboratory.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR SEPTEMBER:—

Sept. 8. 20h. 46m. Jupiter in conjunction with the Moon (Jupiter 4° 56′ N.).

10. 17h. 0m. Saturn at quadrature to the Sun (90° distant).

,, 20h. 0m. Venus in the ascending node.

,, 22h. 14m. Uranus in conjunction with the Moon (Uranus 3° 35′ N.).

14. 20h. 0m. Juno in conjunction with the Moon (Juno 0° 20′ N.).

15. 0h. 48m. Moon eclipsed, invisible at Greenwich.

16. 3h. 0m. Mercury in superior conjunction with the Sun.

22. 4h. 2m. Saturn in conjunction with the Moon (Saturn 6° 59′ S.).

23. 3h. 53m. Sun enters Sign of Libra; autumn commences.

,, 8h. 22m. Mars in conjunction with the Moon (Mars 5° 6′ S.).

25. 0h. 7m. Neptune in conjunction with the Moon (Neptune 5° 0′ S.).

27. 8h. 34m. Venus in conjunction with the Moon (Venus 1° 21′ S.).

29. 16h. 46m. Sun eclipsed, invisible at Greenwich.

30. 12h. 0m. Saturn stationary.

,, 13h. 2m. Mercury in conjunction with the Moon (Mercury 2° 36′ N.).

THE SPECTRA OF THE STARS.—After many years of patient labour by such pioneers as Rutherfurd, Secchi, Huggins, Vogel, Pickering and his co-workers, Lockyer and McClean, the subject of stellar spectra has attracted during the last decade the attention of an ever-increasing number of students in astronomy, astrophysics, physics, and chemistry. This is no doubt thanks in a great measure to the enormous number of spectra classified in connection with the Draper catalogue, but also largely to the simple nomenclature developed by Miss A. J. Cannon, further simplified by the suggestions of Dr. Hertzsprung. Although classification merely has received a great amount of attention of recent years, perhaps partly due to the prominence given to the matter by the Solar Union making it the work of a special committee, yet many important pieces of work have been accomplished beyond. Such are Campbell's and Kapteyn's work on the relations between radial velocities and type of spectrum, the similar work of Lewis Boss on the relation between proper motion and type, the work of Pickering and others on the distribution of stars of particular type of spectrum with reference to the Milky Way, &c. It is perhaps fitting that the importance of the subject should have led to the publication of a summary in the Memoirs of the Society of Italian Spectroscopists, No. 6, from the pen of Signor G. Abetti. It is, however, passing strange that this writer makes no mention of the work of Rutherfurd, Huggins, Lockyer, or McClean, except perhaps that some of them may be referred to in an "&c." Signor Abetti does not deal at all adequately with the literature on the chemical constitution of the stars. He does state, however, that titanium stars are on a level nearer to the helium stars than are the iron stars—a statement for which we know no justification.

EXHIBITION OF THE ROYAL PHOTOGRAPHIC SOCIETY.

THE Royal Photographic Society's annual exhibition at the Gallery of the Royal Society of British Artists, Suffolk Street, Haymarket, is well worth a visit by anyone interested in photography and its applications before it closes on October 4. Besides an excellent collection of works that are notable for their pictorial quality, and that will be examined by technicians as illustrations of the possibilities of the processes that they represent, there is a larger than usual number of colour transparencies, and also exhibits that are of specially scientific interest. The colour transparencies are chiefly autochromes, but there are many on the new Paget plate and a few "Dufays," both of which latter will quite well bear comparison with the autochromes for the quality of their colour and detail. In the scientific section, Lt.-Col. J. W. Gifford shows a large number of original photographs of spectra of the metals taken with a quartz optical train of large aperture. Mr. G. Reboul shows that cuprous chloride, produced by exposing a polished copper plate to chlorine gas, will furnish photographs by treatment somewhat similar to that employed in the production of daguerreotypes. The insecurity of intaglio plate printing for monetary documents is again demonstrated by Mr. A. E. Bawtree in his copies of stamps, the genuine stamp and the forgeries being indistinguishable. The photo-micrographic section is particularly strong. The method of discovering a difference in the colloids present in jams, and of detecting various adulterations, is excellently shown in a series of low-power photo-micrographs by Mr. E. Marriage. Of other series, the "Histology of the Optic Nerve of Sheep," by Mr. J. T. Holder; the "Corpuscular Elements of Human Blood," by Dr. D. H. Hutchinson; and Mr. J. M. Offord's "Diatoms under High Power," deserve special notice. There is a fine collection of radiographs by Dr. Bela Alexander, Dr. G. H. Rodman, Dr. Gilbert Scott, Dr. Robert Knox, and Dr. Thurstan Holland, some taken in a small fraction of a second. In this direction the most novel work is by M. Pierre Goby, who by the use of ultrasoft rays secures quite full details in the most delicate transparent membranes, such as insects' wings, at the same time as showing the internal structure of the insect. But more wonderful are his micro-radiographs, made by using the fine pencil of Röntgen rays that passes through a small hole in a lead screen. The detail in parts of small vertebrates only a fraction of an inch in length, is so well reproduced that a fifteen or seventeen times enlargement would be considered excellently sharp for a direct radiograph. M. Goby applies his method to foraminifera and other minute objects with similar success. Among the other exhibits there are a process with examples of a method of producing colour transparencies by the absorption of dyes in fish-glue, by Mr. Bawtree, and good collections of natural history photographs, lantern slides, and stereoscopic transparencies.

THE ARCHÆOLOGICAL INVESTIGATIONS IN THE MISSISSIPPI REGION.[1]

IN the publication referred to below Mr. Clarence B. Moore gives us another of his very careful descriptions of the systematic excavations he is undertaking in the Mississippi valley, and, as usual, it is profusely illustrated with most excellent photographs and coloured plates. By these investigations and the superb way in which he publishes his results, Mr. Moore is laying a sure foundation for future general-

[1] "Some Aboriginal Sites on Red River." By Clarence B. Moore. Journ. Acad. Nat. Sci., Philadelphia, xiv., 1912.

isations. The last year's work covered 519 miles of the Red River from its confluence with the Mississippi. Few burial places were found in Louisiana, as these were mainly in the often flooded level ground, and the artificial mounds were erected for places of residence; since most of the finds are obtained from graves the spoil was not very large, and as many of the mounds are now utilised they could not be satisfactorily investigated.

Along the Red River in Arkansas the conditions in the main are different; mounds containing burials, some of them richly endowed with artifacts, are fairly abundant, and further northward the lavish use of pottery with burials has often been described. It seems probable that the Arkansas mound burials were those of people of consequence. The pottery of Arkansas is as a rule tempered with fine gravel or sand, or with small bits of pottery, though kitchen vessels are often shell-tempered. The ware is thin and carefully modelled. There are few unusual shapes, grotesque or life forms were very rarely attempted, though they occur in the region to the north. Many vessels bear a high polish, and nearly all have incised designs filled in with red or white pigment. Circles, often series of concentric circles (probably sun-symbols), form a frequently recurring design. Decoration in polychrome was very exceptional, though common more to the north. A remarkable feature—indeed, it is unique—in connection with some of the mounds is the depth of the grave-pits; one reached 15·5 ft. in depth. Among several interesting pipes, two types have not been met with hitherto. One form, from Haley Place, is of earthenware, the truncate conical bowl of which occurs at some distance from the end, the terminal continuation of the stem being hollow; one is nearly 23 in. long. The other, from Gahagan, is moulded to represent a kneeling man; there is a communication between the bowl and the open mouth of the figure, so that smoke can be made to emerge from it when the pipe is in use (Fig. 1). A number of beautiful useful and ceremonial stone implements were found, and various interesting pendants, some of which have the form of a lizard; one was formerly coated with sheet copper, as were also the large circular ear-plugs of limestone. It is, however, impossible to point out all the items of interest in this memoir.

FIG. 1.

Dr. Hrdlička adds a notice on the human remains. He says the skeletons from Haley Place and the McClure mounds probably may be safely ascribed to an extension of the Natchez people; the skulls exhibited deformation of the "Flathead" variety.

A. C. HADDON.

MAGNETIC STORMS AND SOLAR PHENOMENA.[1]

IN the publication referred to below only the first thesis is printed. It deals with the relations between magnetic storms and solar phenomena. The thesis shows the nimbleness of mind one hopes to see in those who have taken high mathematical degrees at Cambridge, accompanied by a knowledge of terrestrial magnetism most unusual in British seats of learning. There are, it is true, researches bearing on the subjects investigated of which the author seems unaware, but his knowledge of foreign writings, including theoretical work by Kelvin, Larmor, Birkeland, Störmer, and Schuster, and observational work by Walker, Airy, Ellis, Maunder, Hale, and many others, is highly commendable. Also the attitude he adopts towards the work he criticises is generally philosophical. Thus, taking Kelvin's attempted demonstration that solar action cannot be the proximate cause of magnetic storms, Bosler points out that there are possibilities not considered by Kelvin making much smaller demands on the sun's stores of energy, and that in the light of modern knowledge no one can say what is a reasonable limit to solar expenditure. On the other hand, he recognises that Kelvin's work directed attention to a point apt to be overlooked.

Dr. Bosler regards his countryman Marchand (1887) as the first to claim a connection between the occurrence of magnetic storms and the presence of individual sun-spots or faculæ near the sun's central meridian, but he regards Maunder's observations on the recurrence of storms in the solar rotation period as the strongest evidence yet advanced in favour of this view. He seems to be unaware of Broun's early work. He apparently accepts Sabine's deduction of an eleven-year period—corresponding to the solar period—in magnetic disturbances, but while recognising the strength of the evidence adduced—especially that of Maunder—in favour of solar jet theories, he considers Dr. Schuster to have demonstrated the impossibility of swarms of any kind of electrified particles sticking together all the way from the sun to the earth. The view he inclines to is that earth currents are the immediate cause of most, if not all, magnetic disturbances. The evidence he advances in favour of this view is derived from comparisons of records of magnetic storms at Parc St. Maur and Greenwich—especially those known as "sudden commencements"—with corresponding records of earth currents. This from an observational point of view is probably the most important part of the thesis, though only partly novel.

The author thinks earth currents may be produced by movements of electrified matter—associated with protuberances, spots, or faculæ—on the sun. Taking the case of a cable of 0·25 cm.^{2} section, made of copper of resistivity 1600, enclosing a circle 8000 km. in perimeter, he calculates that the current induced in the cable by a magnetic field of amplitude 10γ and period 10 sec., normal to the plane of the circle, would at a distance of one metre from the wire produce an alternating magnetic field of amplitude 1250γ. This is adduced as an illustration of how a small field originating in the sun might be amplified on the earth. The idea may be worth considering, but the problem treated seems somewhat too remote from actuality. The magnetician will find a variety of other interesting matter in the thesis.

C. CHREE.

[1] "Thèses présentées à la Faculté des Sciences de Paris pour obtenir le grade de Docteur ès Sciences Mathématiques." By M. J. Bosler. Pp. 96. (Paris: Gauthier-Villars, 1912.)

THE LIFE-HISTORY OF A WATER-BEETLE.[1]

THE life-history of a water-beetle can be outlined in a very few words. An egg is laid by the mother-beetle: an aquatic larva hatches out which feeds and grows, and, during the process of growth, moults several times. When full grown it leaves the water and burrows into the earth, forming a "cell," in which it changes to a pupa. After a time the pupal skin is cast off, and the perfect insect makes its way out of the cell and resumes its life in the water.

There are, however, all sorts of interesting details in the life-history, and these details often differ considerably in different types. There are differences in the egg-laying habits; differences in the method of development of the embryo; differences in the way the larva gets out of the egg; differences in the way it feeds and in the nature of its food, and so on; and it is these differences which are of importance to each species in enabling it to fit in among other species in the life of the community.

Although there are a number of widely separated species of beetles which inhabit the water, there are two groups which are usually referred to as "water-beetles," and these may be broadly distinguished as the swimming carnivorous group—the Hydradephaga—and the creeping herbivorous group—the Palpicornia, or Hydrophilidæ. The description of this second group is not strictly accurate, as the larvæ are, apparently without exception, carnivorous, and the perfect insects, although capable of subsisting upon a vegetable diet, in at least many cases enjoy animal food; and although they are somewhat differently constructed from the swimming water-beetles, some of them are very fair swimmers.

I propose to outline the life-history of a type of the Hydradephaga, and then to compare with it a type of the Palpicornia; and as a type of the former group I will describe a species of Dytiscus, *D. lapponicus*, the life-history of which I worked out during last summer.

The male and female differ in general appearance, the former having smooth wing-cases, the latter having these grooved or fluted. The male has also a pad on each of the front legs, while the female has quite simple front legs. The slide also shows a full-grown larva, and thus gives an idea of the relative sizes of these two stages of the species.

This species is extremely local in the British Islands, only having been found in a few localities in Scotland, and in one in north-west Ireland. It inhabits lochs, usually mere lochans, at altitudes of from 800 ft. upward, and there are certain characteristics about its habitat which make it possible generally to tell at a glance whether a particular lochan is or is not likely to hold the species.

As a rule the habitat is a bare stony lochan, with very little vegetation; it has no stream flowing into or out of it, and trout and *lapponicus* are mutually exclusive. There are usually newts and fresh-water shrimps (*gammarus*), but otherwise there is always a marked scarcity of animal life. Very few other water-beetles are associated with *lapponicus*, which usually is abundant where it occurs.

The only place I have found the species in great abundance is in a lochan 950 ft. above sea-level on the island of Eigg. Along its eastern side this lochan is strewn with large stones, and under these the beetle is to be found, often as many as four or five under one stone. It occurs in other lochans on Eigg, and has been found also in Rhum, Skye, Mull, and Arran, but otherwise it is only known from Inverness-shire.

One place in Mull where it used to occur abundantly is a peculiar loch, situated in the top of a hill, about 800 ft. behind Tobermory. The place looks like the crater of a volcano, but I believe is not so described by geologists. The species has apparently quite disappeared from this loch; it is probably slowly disappearing from our islands, being a remnant of the fauna which abounded when our climate was much colder than it is at present.

All my specimens came from the one lochan on Eigg, and they were placed in large tubs in my garden in the north of Ireland. The tubs are filled with water, but the bottom is covered by a thick layer of soil, and in the soil a few species of water plants thrive, chiefly the common water-grass, *Glyceria aquatica*. The tubs are covered with wire-gauze to prevent the beetles escaping.

Now the Dytiscus possesses a small apparatus capable of piercing the tissues of the water-plants, and each time this borer makes a hole in the water-plant one egg is deposited. In my tubs the *lapponicus* chose the water-grass as the receptacle for its eggs. In its native home this grass does not grow, the only water-plants being a common rush, a species of *juncus*, and the club rush *eleocharis*, both possessing round stems. Now, the grass possesses a round stem surrounded by leaves, each leaf consisting of a long sheathing base and a free lamina or blade. The sheath is keeled, and in every case the mother-beetle pierced the leaf-sheath, and always in the line of the keel, depositing the egg in the tissues of the sheath, and this shows the peculiar instinct possessed by the mother in the deposition of her eggs and the extreme sensitiveness of the borer or ovipositor. Although I examined very carefully the plants in the tubs, only twice did I find that the ovipositor had passed right through the sheath and dropped the egg between that and the stem.

Lapponicus, unlike our other species of Dytiscus has a very definite egg-laying period, commencing in March and ending in June. From two of the British species I have had eggs in October, December, and February, as well as in the summer months.

I collected a number of the eggs, dissecting them out of the leaf-sheaths, and placed them on wet cotton wool in tumblers and watched their development.

I do not intend to weary you with the details of the development of the embryo, but I wish to point out that the embryo first appears on a part of one side of the mass of yolk—it does not at first occupy the whole length of the egg—and it then extends first backwards and then forwards, and the sides grow up around the yolk until the embryo ultimately encloses it. The nerve-chord does not increase in length with the embryo, and consequently appears to shorten as the embryo extends in the egg.

The development of the embryo occupies about three weeks in June, but temperature affects the length of this embryonic period. In the case of another species, an egg laid in April matured in three weeks, while one laid in winter took six weeks to hatch.

Towards the end of the embryonic period the pressure of the embryo in the shell is very great. I accidentally punctured an egg with a needle when turning it over, and immediately a portion of the embryo bulged through, just as the inner tube of a pneumatic tyre tends to bulge through a tear in the outer cover. The pressure is also indicated by the changed shape of the egg during the final stages.

During the latter part of the egg-period, there are various slight movements of the embryo, but during the last few hours certain very definite movements

[1] Discourse delivered at the Royal Institution on Friday, May 9, by F. Balfour Browne.

become noticeable. In the first place, inside the head a spasmodic pulsation is visible, at first at long intervals, but later more or less continuously. I have observed this pulsation in eggs of other water-beetles, and also in those of the dragon-fly, and although I am not sure that the interpretation is the same in dragon-fly and water-beetle, I am satisfied in the latter case the pulsation is really a swallowing process.

The larvæ of all the water-beetles I have examined possess a special sucking apparatus known as a "pharyngeal pump," the use of which I shall describe directly, and in the embryo this pump apparently comes into use to absorb the fluid which surrounds the embryo in the shell; the embryo merely drinks this up.

After this sucking-pump begins to work, various other movements of the internal organs can be observed, including peristalsis, and also at infrequent intervals the whole body moves slightly in the shell, the tendency being to push the head into the end. One other movement is to be noted, and that is an up-and-down motion of the head, at first very slight, but later becoming very marked.

On either side of the head is a small papilla, at the apex of which is a minute, slightly curved spine. When the embryo is at rest, this papilla lies in a slight depression, but when the sucking-pump is at work the papilla bulges outward, so that the spine touches the shell. Thus when the head moves up and down and the sucking-pump works at the same time, the two spines scrape along the inside of the shell and ultimately burst it open. They are, therefore, "hatching spines," and similar instruments differently situated have been observed in a few insect embryos of other orders.

You see, therefore, that the shell bursts open at the head end; immediately it bursts the compressed larva bulges out, and by slight writhing movements works its way clear of the shell, the whole operation taking less than two minutes. As soon as the larva is clear of the shell the tail straightens out, and the legs and mouth parts assume their natural position. In the embryo there is a peculiar fold in the upper part of each jaw, but within two or three minutes of the larva's escape this fold has completely disappeared.

From the moment the larva escapes it begins to grow in length and breadth. The long air-tubes in the body are flat, but have a bright silvery appearance, suggesting that some gas has been secreted in them; but the larva is heavier than the water, and therefore sinks to the bottom. For a time, half an hour or more, it rests quietly and shows no desire to get to the surface, but sooner or later it gets restless and swims to the surface, using its feathered legs as oars, and raises its tail to the surface film and remains suspended for a few minutes. After this the newly hatched larva is buoyant, and cannot remain away from the surface without holding on to the submerged vegetation. The buoyancy is, however, only temporary, as older larvæ frequently require to swim to the surface to renew their air-supply.

In the insect, breathing and blood-circulation are normally not intimately associated as in other animals. In a human being or a fish, or even in a snail, air is taken into special organs—lungs or gills—where the blood takes up the oxygen and carries it through the whole body. In the insect the blood has usually nothing to do with the aëration of the different organs, the whole body being permeated by innumerable air-tubes.

In all the water-beetle larvæ which come to the surface to obtain their air, these innumerable air-tubes communicate with two large air-tubes which run the length of the body, one on each side, and these open on the last segment. Hence, when a larva requires to renew its air-supply it comes up tail first, bringing the openings of the two lateral tracheæ into communication with the air, and by contracting and expanding the body it exhales the used-up air and inhales fresh air.

For a day or so after hatching the larva is soft and is not hungry, but once its skin and jaws have hardened it begins to look about for food. I found that tadpoles and pieces of chopped worm were suitable food, but under natural conditions small newts, water-shrimps, and insect larvæ—including brothers and sisters—constitute the normal diet. It is impossible to keep two larvæ together in one small vessel, as one invariably attacks and kills the other within a few hours. Even when I gave a tub to four specimens only one survived after a few weeks, so that in a small loch, where at least some thousands of these larvæ hatch out, the death-rate must be enormous.

The method of feeding of the larva is peculiar. The two long sharply pointed jaws are each pierced with a fine tube, of which one end opens on the inner side just below the apex, and the other end opens on the upper side just near the base. When the jaws are closed the inner ends of these tubes communicate with the corners of the mouth, but when the jaws are open the inner ends of these tubes do not communicate with the mouth at all. The mouth itself is also peculiar. In a front view of the head it is visible as a long narrow slit between the bases of the jaws, but if this slit is examined it is found that across the lower side of it is a raised ridge which fits into a groove running across the upper side of it. When the jaws are wide apart the ridge and groove are separated, and the mouth is open, but as soon as the jaws come together the ridge fits into the groove, and the mouth is closed. As soon, therefore, as the larva seizes its prey its mouth is closed, and the only communication into it is through the tubes in the jaws, the basal ends of which now open into the corners of the mouth.

Immediately behind the mouth is the powerful sucking-pump, the pharynx, which I mentioned in connection with the embryo. By expansion and contraction of its muscles it sucks in the juices of the prey through the tubes in the jaws. But if this were the whole process of feeding there would be a considerable waste, as a worm or a tadpole consists of a large amount of solid material; and yet, if one watches one of these larvæ feeding, one will find that almost nothing is left of the prey except the skin. This is due to the fact that at short intervals the sucking-pump stops working and saliva is poured into the prey. This saliva digests and dissolves away the solid parts of the food, which are then sucked in by the larva. The process of digestion, which in most animals takes place internally, is carried on in these larvæ outside the body.

With regard to the *duration of the larval period*, in my examples this varied from six to nine weeks. This period is divided into three stages, there being two moults prior to the final one which produces the pupa. Each of the first two stages only lasts about ten days, so that the last stage is a very long one, as it is in all other insects.

This last stage is also divisible into two parts, the first occupying four or five weeks, during which the larva feeds and grows as in the previous stages, the second occupying two to four weeks, being spent out of the water making a cell in the earth, and resting preparatory to becoming a pupa.

In the few cases which I had the opportunity of observing, the full-grown larva always left the water in the morning between eight and ten o'clock; but whether this is the rule with this species, or whether it was connected with the artificial conditions in which my larvæ were reared, I do not know.

Once the larva leaves the water it crawls about very actively, seeking a suitable place to enter the earth. If left to itself it usually selected a stone and burrowed underneath it, but I found that if I made an artificial burrow—with a pencil, for instance—the larva could be made to crawl into this, and as a rule would make its "cell" in it. By making such a burrow against the glass side of a box filled with earth, I was able to watch the process of the formation of the pupal cell.

Once the larva has entered and adopted the burrow, it straightway begins to prepare its cell, and this is done by enlarging part of the burrow. The jaws are now used for transporting pellets of soil from one position to another, and for breaking up the pellets into their separate particles. Very little earth is actually pushed into the unused part of the burrow, the cell being formed almost entirely by breaking up the pellets of soil and battering the fine particles against the sides. The vertex of the head is the main battering-ram, but the larva, which during the whole process of making the cell lies with its tail bent over its head, also flattens out the earth with its body.

The actual making of the cell occupies about twelve hours, and during that time the larva does not rest for a moment. At the end of that time it is apparently tired out, and rests in any position, often stretched across the cell, its head pressed against one side and its curved body against the other. It thus rests for about twenty-four hours, after which it bends its tail underneath it and usually adopts a sitting-up position—reminding one of Tenniel's illustration in "Alice in Wonderland" of the caterpillar sitting on the mushroom. It is, however, very restless, and frequently changes its position, tossing from side to side.

The pupa appears, after the larva has been thus resting for a fortnight or more, by the larval skin splitting along the back and being cast off at the tail end. On its back are to be seen a number of short projecting spines, and Lyonnet suggested in the case of another pupa, similarly though better equipped, that these are for the purpose of raising it off the damp soil of the cell. This may be true, but in my experience the pupa most usually lies, so to speak, on its face rather than on its back.

The pupal stage lasts about three weeks, and the only change noticeable during that time is a slight pigmentation of what is at first a perfectly white pupa. At the end of the pupal stage the skin ruptures along the back, and the perfect insect comes forth at first white and soft, but in the course of two or three days it assumes its normal coloration, and after a longer period its normal hardness. After a week or so it makes its way out of the pupal cell by biting and scraping, and at once goes to the water.

In its native haunts it spends most of its time amongst the stones and mud at the bottom, occasionally coming up to renew its air-supply, and in my tubs also it was seldom to be seen.

With regard to its winter habits, it apparently buries itself at the bottom of the loch as soon as the cold weather begins, and sleeps until the following spring. In my tubs it disappeared completely in October or November, burrowing deep into the soft oozy mud at the bottom, and there it remained until the following March. During all this time the metabolic processes must be practically at a standstill, as otherwise the insect would require to renew its air-supply at frequent intervals.

Having now outlined the life-history of this type of the swimming carnivorous water-beetles, I will take an example of the other group, and the one I have chosen goes by the name of *Hydrocharis caraboides*. There is only one species of Hydrocharis in the British Islands, and it is practically confined to the south-east of England, only very occasionally having been found anywhere else in the country. It inhabits stagnant ponds and drains, and is not uncommon in a few places in Surrey, Essex, and Middlesex.

I began to experiment with it five years ago in the north-east of Ireland, having obtained my specimens from Surrey. Each year I obtained eggs, reared the larvæ, and renewed and increased my stock, so that it is obviously not the climate of north-eastern Ireland which prevents this species from being a native there.

The conditions in my tubs were just such as are to be found in any pond or drain in the country, and apparently the only reason why this species is confined to the south-east of England is that competing species prevent it from extending its range.

Whereas Dytiscus lays its eggs singly in holes pierced by it in the living vegetation, Hydrocharis builds an elaborate silken cocoon which floats in the water, and in which about fifty eggs are deposited.

The spinning of the cocoon is a wonderful process. The beetle carries on its underside a film of air, which is part of its supply for breathing. The cocoon is actually spun on a part of this film of air, which is then detached from the rest of the film as a bubble enclosed in silk. The egg-laying commences soon after the cocoon is begun, and the eggs are arranged side by side in the cocoon standing upon one end, being fastened in position by silken threads. A space above the eggs is filled with very loosely woven silk.

In closing up the cocoon a peculiar plate-like structure is formed of very closely woven silk, and this ends in an upward projection known as the "mast." The purpose of this "mast" is not known. It is not a tubular structure, but merely a band of silk. It has been stated that if it is cut off the eggs die, but in the case of another species I have hatched eggs removed from the cocoon and submerged, so that the suggestion that the mast is necessary for keeping up the air-supply is without foundation.

I shall not weary you with details of the development of the embryo beyond mentioning that, unlike Dytiscus, the embryo from the first occupies the whole length of the egg, and that the nerve chord, again unlike Dytiscus, grows with the embryo as it develops. The only other point I need mention is that in the cocoon all the embryos develop head downwards.

The egg-laying period of Hydrocharis extends from about the middle of May until about the middle of July in my tubs, but it may perhaps be rather longer in the south-eastern parts of England. The incubation of the egg occupies nine or ten days, and, as in the case of Dytiscus, towards the end the embryo is very tightly packed within the shell. There is, however, no special hatching apparatus that I have been able to find. The pulsating organ or sucking-pump in the head is visible, and there are also movements of the embryo, but at the end the skin splits along the back and the larva treads it off, giving a peculiar backward wriggle.

Now, under normal conditions the newly hatched larva does not at once leave the cocoon; in fact, it does not appear for one or even two days after hatching. As soon as it bursts the egg-shell it wriggles backwards out of the egg into the space above all the eggs, and it is interesting to note that the hairs on the body of the newly hatched larva all point forwards. As the larvæ hatch, the empty shell and the silk bindings become broken down—I think they are chewed by the larvæ—and the whole cocoon ultimately becomes filled with the larvæ.

In those cases where I dissected the eggs out of the cocoon and allowed them to develop on the wet cotton wool, the newly hatched larvæ congregated into a mass and remained so for a day or two, after which they became active in search of food.

You will notice that the larva possesses on each body segment a pair of lateral processes, and on the last segment a pair of ventrally placed processes of a different kind. These latter, which are possessed by all water-beetle larvæ which come to the surface for their air, have probably some connection with raising the tail to the surface for breathing, but the hairy lateral processes have been called gills. Many larvæ of the Palpicornia have lateral processes, usually smaller than those of Hydrocharis, but in no case are they really gills, and the larvæ quickly drown if prevented from bringing their tails to the surface to renew their air-supply.

The larvæ of Hydrocharis, like those of Dytiscus, will eat almost any kind of animal matter, and hence they are easily supplied. I fed them mostly upon chopped worms, but their method of feeding is very different from that of Dytiscus. They seize their food with the jaws, antennæ, and the other mouth parts, and they then come to the surface, and raising their heads and part of the body out of the water, they proceed to chew up the food by opening and closing the jaws, turning it from time to time with the other mouth parts. The jaws are not perforated, nor is there any mouth-lock as in Dytiscus, and they suck in the juices of the prey by the mouth, spitting up saliva at intervals, which actually froths over the food and digests it, the dissolved material then being sucked down. The external digestion is so complete that in the case of a thick piece of worm all that is ultimately rejected is the thin transparent outer pellicle.

In the mouth parts of the larva I want to direct your attention to a curious want of bilateral symmetry, noticeable not only in the jaws—one of which, the left, has a small extra tooth near its base—but also in the upper lip. In many species there is an absence of bilateral symmetry where a pair of organs are complementary. Thus in the jaws of the beetle itself, the base of the left one is hollowed out to receive the base of the right one, which is convex, the two being related as pestle and mortar for grinding up the food. The larva of another species of the same group also shows asymmetry of the jaws, but here again it is definitely associated with the method of feeding. This species feeds upon pond snails, and the left jaw holds the shell while the right jaw with its large double tooth cuts through it.

The asymmetry of the upper lip, however, is at present inexplicable, and, curiously enough, it occurs in several other species.

The larva of Hydrocharis, like that of Dytiscus, passes through three stages, the first two of which occupy from five to eight days, and the third stage, up to the time the larva is full grown, occupies about four weeks. It then leaves the water and burrows into the earth, forming a cell, just as the Dytiscus larva did. I had many specimens of these larvæ, and so made many experiments with them, and one curious fact about them is that the instinct which leads them to burrow into the ground and make a pupal cell only lasts for one or, at most, two days. In no case, where I removed a larva even immediately after the completion of its cell, did it make any attempt to form another one, and if left on the surface of the soil it moved about listlessly and ultimately died, apparently of drought, since if placed in a damp position, for instance, in an artificial cell, it survived and pupated. If a cell was damaged before completion the larva often completely destroyed it, apparently in the attempt to repair the damage, and would be found sitting amongst the ruins.

Once the cell is completed the larva rests for about three weeks, at the end of which time the skin is cast off and a greenish-white pupa appears. This is more spinose than that of Dytiscus; but it also prefers to lie upon its face, resting upon the two small tail projections and upon the "collar" of the prothorax.

The perfect insect appears after about ten days, so that the whole life-cycle occupies about nine or ten weeks from the laying of the egg to the appearance of the perfect insect. This time, however, may be greatly prolonged under less favourable conditions. Thus, the later egg-cocoons produce larvæ which take twelve or fourteen weeks to grow up, and the cocoons built in July produce beetles which do not leave the pupal cell for six or seven months. The larvæ leave the water in September and even in October, and after three or four weeks turn into pupæ. These pupæ turn into beetles in late October or November, but the beetles remain, apparently torpid, until the following March or April, when they make their way out and to the water.

I have mentioned that the larvæ of both Dytiscus and Hydrocharis breathe in the same manner by raising the tail to the surface. The perfect insects, however, assume very different positions when taking in their air-supply.

Dytiscus floats up to the surface tail first, taking in air between the body and the great wing-cases which cover it, and it is in this cavity under the wing-cases that the whole reserve of air is carried.

On either side of the body under the wing-cases is a row of pits, spiracles; the last pair of these are much larger than the others. When the insect rises tail first to the surface, the tubes connected with this last pair contract and expand, just as in the larva, renewing the air-supply in the whole tube system, while at the same time the body contracts and expands, renewing the reserve supply under the wing-cases.

Hydrocharis, on the other hand, comes to the surface head first, turns its head on one side, and pushes its short, club-like antenna through the surface-film. Now a large part of the under side of this beetle is covered with fine velvety hair, which retains a thin film of air upon it, just as a piece of velvet does when gently pushed under water. When the beetle raises its antenna above the water it brings this film of air into communication with the air above the water. It also has a reserve supply under its wing-cases, and this communicates at the sides with the ventral film, and by expansion and contraction of the body the used-up air is expelled above the water and fresh air is taken in. In Hydrocharis the most important spiracles are situated well forward, and thus the used air from the air-tubes is expelled and fresh air taken in at the front end of the body instead of the tail end.

Anyone who examines Hydrocharis and compares it with Dytiscus will at once see great structural differences. In a ventral view of the two types, comparing the heads, the most noticeable difference is in the antennæ, which are filamentous in the former and clubbed in the latter, and the maxillary palpi, which are short in the former and long in the latter, in which they are used under water as feelers, just as are the antennæ of Dytiscus.

Passing over other less remarkable differences in the heads of the two types and coming to the body, one at once notices the different disposition of the legs: in Dytiscus the first two pairs are close together, in Hydrocharis the three pairs are about equidistant. In Dytiscus the basal segment of each hind leg—the coxa marked 3* on the screen is large, and the two coxæ are fused into a single piece which is firmly fixed into the body. In Hydrocharis the coxa is long and narrow; the two coxæ are separate, and each is hinged on to the body. The firm fixing in Dytiscus gives it a much more powerful leg-drive than the hinging gives to Hydrocharis, and hence Dytiscus is a more efficient swimmer.

These differences between the two types are therefore connected with differences in function. The antennæ of Dytiscus are feelers, while those of Hydrocharis are connected with breathing, and the disposition of the legs and their methods of attachment to the body are connected with differences in mode of progression, Dytiscus being a "swimmer," and Hydrocharis chiefly a "creeper" on the submerged vegetation.

In these two groups of water-beetles, the Hydradephaga represented by Dytiscus and the Palpicornia represented by Hydrocharis, we have two types of adaptation to an aquatic existence. Each type has originated independently of the other—that is, they are not descended from a common aquatic ancestor. Each represents a part of a large terrestrial family, and each has probably developed an aquatic habit as a result of competition, stronger land forms having driven the weaker off the land and into the water.

Just as each group has originated under the stimulus of competition, so, within each group, competition has moulded the different forms, and the peculiar details in the life-history of any one form are just those which enable it to retain its place in the community to which it belongs, and to hold its own in the great struggle for existence.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE announcement is made of the resignation of Dr. A. L. Bowley of the professorship of mathematics and economics at University College, Reading.

PROF. J. S. KINGSLEY, of Tufts College, has been appointed professor of zoology, in charge of vertebrates, in the University of Illinois.

DR. K. F. MEYER, director of the laboratories of the Pennsylvania State Livestock Sanitary Board, has vacated that position to fill the chair of bacteriology at the University of California. Dr. J. B. Hardenbergh has been appointed to succeed Dr. Meyer in the first-named post.

PROF. HERBERT V. NEAL, who has held the chair of biology at Knox College, Illinois, since 1897, has accepted an appointment to a similar post at Tufts College, Massachusetts. He has already had some acquaintance with the work of that college, having been for the last five years an associate director of the Tufts biological laboratory at S. Harpswell, Maine.

IT is announced in *The Indian Medical Gazette* that the scheme for the establishment of a School of Tropical Medicine in Calcutta is now so far advanced towards fulfilment that there is every reason to hope that it will be opened in the autumn of next year. Already valuable work on cholera, epidemic dropsy, dysentery, and other diseases has been done by a few workers in Calcutta. What is now wanted is money. Our Indian contemporary asks for substantial endowments of three or four lakhs for several additional research chairs, or annual subscriptions of 20,000 rupees for each.

AN effort is about to be made to raise a fund of 20,000*l*. for the foundation of a chair of engineering chemistry at Princeton University. This campaign will be undertaken mainly by members of the federation of Pinceton clubs of New Jersey, with the object of the advancement of chemical industries in that State. The course of instruction to be given by the occupant of the proposed chair will supply engineering students with a knowledge of the commonest construction materials of the chemical industries, and of various materials that now take the place of the direct products of the soil.

A COURSE of lectures on tuberculosis, for general practitioners and especially for candidates as tuberculosis officers, has been arranged by the Royal Institute of Public Health. The introductory lecture will be delivered by Prof. G. Sims Woodhead on October 10. Subsequent discourses will be given by Dr. C. Porter ("The problem of Tuberculosis in relation to Insurance and Public Health"), by Prof. Woodhead ("The Spread of Tuberculosis"), by Dr. J. E. Squire ("Diagnosis"), by Dr. T. N. Kelynack ("Tuberculosis in Childhood"), by Dr. C. Wall ("General Treatment"), by Dr. C. Riviere ("Specific Treatment," &c.), by Dr. T. D. Lister ("Sanatorium Treatment"), by Dr. A. Greenwood ("The Prevention of Tuberculosis"), and Dr. H. O. West will outline a co-ordinated scheme for dealing with the malady.

THE medical schools of London and the provinces are beginning to announce the opening functions of their winter session. Prof. Sir William Osler, Bart., F.R.S., is to distribute the prizes and deliver an address at St. George's Hospital on October 1; at St. Mary's Hospital, Paddington, the prizes will be presented and an address given by Sir John Prescott Hewett, K.C.S.I., on the same date; Mr. W. Sampson Handley will deliver an address and Sir Squire Bancroft distribute the prizes at the Middlesex Hospital on October 1, on which date also Sir Charles Pardey Lukis, K.C.S.I., will give an address at the London School of Medicine for Women. On October 7 a lecture will be delivered at the University of Birmingham by Prof. Arthur Keith, F.R.S., on "The Present Problems relating to the Antiquity of Man"

MUCH interesting information as to the progress of secondary education in England is contained in the recently published Blue-book (Cd. 6934), "Statistics of Public Education in England and Wales, Part i. Educational Statistics, 1911–12." During the school year dealt with, there were in England 885 efficient secondary schools receiving grants from the Board of Education; of these 358 were for boys, 311 for girls, and 216 admitted both boys and girls. The teaching in these schools was in the hands of 9126 full-time teachers, of whom 4584 were men and 4542 women; and they were assisted by 3082 part-time instructors. The schools were attended by 150,605 pupils 81,383 boys and 69,222 girls. Of the total number of pupils 30,427 were under twelve years of age, 98,623 were between twelve and sixteen years of age, 11,553 between sixteen and eighteen years of age, and 0·6 more than eighteen years of age. As regards the management of the schools, it may be pointed out that 328 were provided by local education authorities, 427 were foundation and other schools, 48 were Roman Catholic schools, and 28 Girls' Public Day School Trust schools.

THE prospectus for the session 1913–14 of the Day and Evening College for Men and Women at the South-Western Polytechnic Institute, Chelsea, has been received. The day college is intended for students above the age of sixteen, and the courses of study are suited for technological and university purposes. The prospectus, we observe, points out that those who enter for technical instruction should have received previously a sound English education and should have acquired an elementary knowledge of mathematics and, if possible, of physics and chemistry. The courses are arranged to occupy three years.

On entering the student is asked to state whether he wishes to be trained as a mechanical or electrical engineer, or as a consulting or industrial chemist. In any of these cases he will find mapped out for him a complete course of study, involving laboratory instruction, tutorial work, attendance at lectures, exercises in mathematics, geometrical, mechanical, and architectural drawing, and instruction in the workshops. Evening courses in almost every branch of pure and applied science have been arranged at very moderate fees, and in their anxiety that no properly qualified person should be debarred from attending classes through inability to pay fees, the governors have arranged that apprentices, learners, and improvers, under the age of twenty-one years, may be admitted to all classes and courses at half-fees, on production of their employer's certificate.

The prospectus of the Belfast Municipal Technical Institute for next session has been received. The object of the institute is to provide instruction in the principles of those arts and sciences which bear upon the industries of Belfast, and to show by experiment how these principles may be applied to their advancement. A day technical course has been established to give instruction in mechanical engineering, electrical engineering, the textile industries, and pure and applied chemistry. The course provides a sound training for youths who aim at filling positions of responsibility in various industries. A trade preparatory school, which constitutes a junior section of the day technical department, provides a specialised training for boys who are intended for industrial occupations. The evening classes are suitable for persons engaged during the day who desire to supplement the knowledge and experience gained in the workshop or warehouse. The needs of women are catered for in the same complete manner as those for men. It is not possible here to enumerate all the interesting ways in which the technical instruction committee has endeavoured to assist local industries, but mention may be made of the public textile testing and conditioning house which has been opened in the institute. It undertakes the examination of textile materials with the view of ascertaining their true weight, length, strength, and so on; and it carries out such other investigations as manufacturers and others may desire.

Pamphlets giving full particulars in connection with the faculty of medical sciences and with the faculty of engineering for the coming session have been published by University College, London. The college faculty of medical sciences comprises the departments of physics, chemistry, botany, and zoology (the preliminary medical sciences), also the departments of anatomy, physiology, and pharmacology (the intermediate medical sciences), and the departments of hygiene and public health, and of pathological chemistry (post-graduate study). Full preliminary and intermediate courses of study are provided for students desirous of obtaining the medical degrees of the University of London, as well as for students seeking the qualifications of other universities and licensing bodies. Each of the departments is also equipped for more advanced work, and provides facilities for research. The faculty of engineering, including the departments of mechanical, heating and ventilating, electrical, civil and municipal engineering, is intended to provide for students wishing to devote themselves to engineering a systematic training in the application of scientific principles to industrial purposes. The courses are also suited to the requirements of students who intend to enter for appointments in the Indian Public Works Department, Engineering Department of the General Post Office, Department of the Director of Engineering and Architectural Works in the Admiralty, Patent Office, and other similar services, or of those who intend to become patent agents, technical teachers, and chemical engineers. The engineering departments have been recognised by the Board of Trade as providing suitable technical training for marine engineers. Facilities are provided for post-graduate and research work in all the subjects.

The Yorkshire Summer School of Geography, organised this year by the University of Leeds, completed a successful inaugural session on August 23. More than a hundred students were in residence for three weeks at and near Whitby, the headquarters being in the new buildings of the County School, which were kindly lent for the purpose by the governors. Systematic instruction in the methods of modern geographical study was aimed at by choosing Yorkshire as a representative area, and studying as exhaustively as possible all the factors and relationships connected with its structure and location. A course of five lectures on the physical geography and special geological features of the district was given by Prof. P. F. Kendall, together with lectures on the North Sea, and on meteorology by Mr. A. Gilligan. This led to the study of special topics of industrial or historical character, including plant distribution and agriculture (Dr. W. G. Smith), metalliferous and coal mining (Mr. A. Gilligan), the textile and metallurgical industries, ports, fisheries and communications (Mr. Ll. Rodwell Jones), prehistoric Yorkshire (Prof. P. F. Kendall), the Roman occupation (Mr. P. W. Dodd), Saxon and Danish Yorkshire (Mr. W. G. Collingwood), mediæval Yorkshire (Mr. H. B. McCall), architecture (Mr. S. D. Kitson), place-names and language (Prof. Moorman), Old Whitby as a port (Mr. E. H. Chapman), and river development (Prof. Kendall). The course concluded with two lectures on the teaching of geography by Mr. W. P. Welpton. The practical work included the reading and enlargement of topographical maps, the examination of typical rocks, the making of models and microscope sections, field surveys, and the reading and construction of meteorological charts. Frequent excursions were made to places of geological and industrial interest in the neighbourhood, and an afternoon was devoted to the study of a typical Yorkshire farm, with large-scale plans showing the rotation of crops on each field for the past four years.

SOCIETIES AND ACADEMIES.

Calcutta.

Asiatic Society of Bengal, August 6.—E. Digby. Nor'-westers and monsoon prediction. Nor'-westers have hitherto received little scientific attention. The entire literature is covered by a monograph by Sir John Eliot in 1876 and certain observations in a paper of his in 1910 on the anemographic records of Saugor Island. His observations and deductions are summarised. The structure of a typical nor'-wester is analysed. Its form and motion appear to show it is not a cyclonic eddy but a rectilinear splitting of the still-air layer between the lower southerly and upper northerly wind, which takes place transversely to the direction of motion of the storm mass. The absence of hail and the rapidity of the motion support this theory. A typically complete nor'-wester indicates a strong northerly upper current, and therefore the probability that the advance of the monsoon will be delayed. Weak or ill-formed nor'-westers indicate a weak upper current and little opposition to the monsoon. The factors that require study are briefly enumerated and divided into those which can be noted by individual observers and those which require co-ordinated effort.

BOOKS RECEIVED.

Michigan Agricultural College. Experiment Station. Division of Soils. Technical Bulletin No. 17: An Investigation of Soil Temperature and some of the most Important Factors Influencing it. By G. J. Bouyoucos. Pp. 196. (East Lansing, Michigan.)

Animals of the Past. An Account of some of the Creatures of the Ancient World. By F. A. Lucas. Pp. xxi+266. (New York: American Museum of Natural History.) (Handbook Series No. 4.)

The Climate and Weather of San Diego, California. By Ford A. Carpenter. Pp. xii+118. (San Diego: Chamber of Commerce.)

New South Wales. Department of Mines. Geological Survey. Mineral Resources, No. 17: Report on the Cobar Gold-field. By E. C. Andrews. Part i. Pp. x+207. (Also Maps to above.) (Sydney.) 7s. 6d.

Lord Lister: his Life and Work. By Dr. G. T. Wrench. Pp. 384. (London and Leipzig: T. Fisher Unwin.) 15s. net.

Fabre, Poet of Science. By Dr. C. V. Legros. Translated by B. Miall. Pp. 352. (London and Leipzig: T. Fisher Unwin.) 10s. 6d. net.

Die Gärungsgewerbe und ihre naturwissenschaftlichen Grundlagen. By Prof. W. Henneberg and Dr. G. Bode. Pp. v+128. (Leipzig: Quelle and Meyer.) 1.25 marks.

Wie ernährt sich die Pflanze? Naturbeobachtungen draussen und im Hause. By Otto Krieger. Pp. v+188. (Leipzig: Quelle and Meyer.) 1.80 marks.

Geschichte des naturwissenschaftlichen und mathematischen Unterrichts. By Prof. F. Paul. Pp. ix+368. (Leipzig: Quelle and Meyer.) 8.60 marks.

Note sur une Illusion de Relativité. By M. Gandillot. Pp. 88. (Paris: Gauthier-Villars.) 6 francs.

Chemistry and its Relations to Daily Life. By Prof. L. Kahlenberg and Prof. E. B. Hart. Pp. vii+593. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5s. 6d. net.

Board of Education. Reports for the Year 1911–12 from those Universities and University Colleges in Great Britain which are in Receipt of Grant from the Board of Education. Vol. I. Pp. xxxi+465. (Cd. 7008.) 2s. Vol. II. Pp. ii+454. (Cd. 7009.) 1s. 10d. (London: H.M. Stationery Office; Wyman and Sons, Ltd.)

The Peregrine Falcon at the Eyrie. By F. Heatherly. Pp. x+78. (London: "Country Life" Offices; G. Newnes, Ltd.) 5s. net.

Einführung in die Allgemeine Biologie. By Prof. W. T. Sedgwick and Prof. E. B. Wilson. Autorisierte übersetzung nach der Zweiten auflage by Dr. R. Thesing. Pp. x+302. (Leipzig and Berlin: B. G. Teubner.) 6 marks.

Himmelsglobus aus Modelliernetzen die Sterne durchzustechen und von innen heraus zu betrachten. By Prof. A. Höfler. (In drei Ausgaben.) Ausgabe i. (Leipzig and Berlin: B. G. Teubner.) 1.50 marks.

A Laboratory Manual of Invertebrate Zoology. By Dr. G. A. Drew. Second edition, revised. Pp. ix+213. (Philadelphia and London: W. B. Saunders Co.) 6s. net.

Ergebnisse der Zweiten Deutschen Zentral-Afrika-Expedition, 1910–1911. Unter Führung Adolf Friedrichs, Herzogs zu Mecklenberg. Band i.: Zoologie; Teil i., Hamogregarinen. By Dr. H. Schubotz. Pp. 22+4 plates. (Leipzig: Klinkhardt and Biermann.) 1.60 marks.

Gas Testing and Air Measurement. By C. Chandley. Pp. vii+77. (London: Methuen and Co., Ltd.) 1s. 6d.

A Text-Book of Geography. By A. W. Andrews. Pp. xii+655. (London: E. Arnold.) 5s.

A Text-Book of Physics. By Dr. R. S. Willows. Pp. viii+471. (London: E. Arnold.) 7s. 6d. net.

University of Pennsylvania. The Museum Publications of the Babylonian Section, Vol. iii.: Aramaic Incantation Texts from Nippur. By Prof. J. A. Montgomery. Pp. 326+xli plates. (Philadelphia: University Museum.)

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part x. Pp. v, vi+9 plates+descriptions Nos. 75–83. (London: W. Wesley and Son.) 3s. 6d. net.

The Differentiation and Specificity of Starches in Relation to Genera, Species, &c. Stereochemistry applied to Protoplasmic Processes and Products, and as a Strictly Scientific Basis for the Classification of Plants and Animals. By Prof. E. T. Reichert. Part i. Pp. xvii+342+21+102 plates. Part ii. Pp. xvii+343–900+18. (Washington, U.S.A.: Carnegie Institution.)

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2289, VOL. 92] THURSDAY, SEPTEMBER 11, 1913 [PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.

THURSDAY, SEPTEMBER 11, 1913.

THE STATE MYCOLOGIST IN THE COLONIES.

Handbook of Fungus Diseases of the Potato in Australia and their Treatment. By D. McAlpine, Department of Agriculture, Victoria. Pp. iii+215+1 map. (Melbourne: J. Kemp, Government Printer, 1912.)

THIS handbook records matters of scientific interest to economic mycologists in all countries, while, at the same time, it is written with the aim (which is certainly achieved) of giving valuable information and assistance in practical matters to the Australian farmer. In the latter direction Dr. McAlpine has performed, indeed, a public service.

The book deals in detail with *Phytophthora infestans, Alternaria solani,* Rhizoctonia, "scab," *Fusarium solani,* and *Bacillus solanacearum,* and is illustrated with 158 excellent photographs. In a very instructive appendix are given the various legislative "orders" relating to potato diseases which have been put into force under the "Vegetation Diseases Acts" and "Quarantine Act" of Australia.

The author states that in Australia the annual value of the crop is more than one-and-a-half million pounds sterling. He rightly insists on the economic importance of all steps being taken by the State, and by the individual, to safeguard the health of the crop, and remarks:—"Some of the worst diseases with which the [potato] grower has to contend in Britain and elsewhere are not known here, simply because the fungi causing them have not been introduced, and with a Quarantine Act in existence they are not likely to be."

The *educational* value of the legislation against plant-diseases is shown by the following observation:—

"There is a widespread desire on the part of growers to know more about the diseases of the potato, for the ignorance of the past can no longer be tolerated, since there is a rigid system of inspection to prevent diseased tubers passing from one State to another."

With regard to all the diseases mentioned, a number of highly interesting experiments and observations are recorded. In the case of *Phytophthora infestans* it is shown that sporangia can infect the unbroken skin of healthy tubers; and that the mycelium can remain living in a dried-up tuber ("as dead as a mummy," to quote the author's words) for more than four months. Interesting facts are given as to the different characteristics the disease shows in Australia, as compared with Great Britain and particularly Ireland; while the tubers are attacked in Australia, there is, generally speaking—owing to the prevailing hotter weather—no sudden blackening and decay of the tops. This difference not unnaturally led potato-growers in Australia, particularly those who had had experience of the "blight" in Ireland, to the error of supposing that the two diseases were distinct. (The speculation naturally suggests itself whether a distinct form of *P. infestans* may not arise in Australia, specialised to these new conditions of temperature and humidity.) It is found that the "kangaroo apple" (*Solanum aviculare*) serves as a host-plant; while it is stated that *S. nigrum,* a common weed in Australia, appears to be immune. Another very interesting fact which has been ascertained is the undoubted connection of the severity of the disease with the rainfall in different districts.

A full discussion is given of the life-history of *P. infestans.* Here, as with so many common fungous diseases, there are important gaps in our knowledge waiting to be filled; it is necessary to take every opportunity to point out that in no department of botany is research needed more than in economic mycology. The author remarks: "probably the mycelium remains dormant in the [potato] stalks"; such statements are to be deprecated—it is better to admit the absence of definite knowledge.

A series of experiments showed that the Fusarium of the potato and tomato are transferable; excellent photomicrographs are given of the life-history and stages of development of this fungus.

E. S. S.

PHYSICAL TRAINING.

Ma Leçon-Type d'entraînement complet et utilitaire. By Lieut. G. Hébert. Pp. 208. (Paris: Librairie Vuibert, 1913.) Price 1.75 francs.

ON reading this book most people interested in physical training will agree that although the training it describes may be *utilitaire,* it is certainly not *complet.* The training aims at the acquirement of strength and endurance, as do all forms of physical training and many forms of sport. But M. Hébert's system lacks the completeness and variety of the Swedish system, which is the system now used in our Army and Navy and in an increasing number of schools in this country. There is nothing M. Hébert claims for his method which is not equally true of the Swedish method.

M. Hébert divides exercises into seven classes: (1) marching; (2) running; (3) jumping; (4) climbing; (5) lifting; (6) throwing; (7) exercises of defence—boxing and wrestling. What are called balance movements in the Swedish system, as well as abdominal movements, are included in a truly "utilitarian" manner in climbing exercises. So far as abdominal movements are concerned, this does not allow graduation of resistance, which is a matter of importance. There is little variety of limb exercises, and the group of back exercises, so valuable for their corrective effect in regard to the faulty positions assumed in most occupations, are entirely omitted. Head and neck exercises are also omitted, while lateral trunk movements are only used as applied movements, and are therefore not graduated.

The more definite grouping of movements in the Swedish system allows of a more graduated and equal training for each part of the muscular system, each group of muscles, and, therefore, of the body as a whole. Free trunk movements, lateral and otherwise, are obviously of value in acquiring strength, flexibility, and complete coordination. Free arm movements are of greater value for the normal development of the arms and chest than movements of lifting and throwing.

In a Swedish gymnastic lesson the hardest work is performed in the middle of the lesson, the amount of exertion being graduated throughout. M. Hébert also graduates the amount of work, but leaves the hardest work to be performed towards the end of the lesson. The effect of the former method on circulation and respiration, and on the distribution of blood in the body, is more desirable physiologically.

M. Hébert lays due stress on the importance of deep breathing, and of complete expiration as well as inspiration. On the other hand, he recommends as an exercise slow marching, breathing in during four to six steps, breathing out during four to six steps, either with or without an intermediate respiratory pause with expanded chest for one or two steps. This method of breathing would undoubtedly tend to produce over-expansion of the chest, with loss of elasticity and accompanying emphysema. Marching with the hands crossed behind the back (Fig. 18) also tends to fix the chest and hinder complete expiration, besides producing a bad position of the shoulders and often hollow back. Sun and air baths and gymnastics in the open air are recommended, the body being uncovered except for a short pair of drawers, unless the weather is specially inclement, or the sun very hot, when a protective covering for the head and back of the neck is added.

The illustrations as a whole are excellent, although some of those which illustrate jumping appear to show that the height of the jump is considered more than the correctness of the attitude in jumping (Fig. 94).

The book is arranged clearly, and is much more readable than the more severe and "complete" gymnastic treatises.

MINA L. DOBBIE.

OUR BOOKSHELF.

L'Aviation. By Prof. P. Painlevé, Prof. E. Borel, and Ch. Maurain. Sixième edition. Pp. viii+298. (Paris: Librairie Felix Alcan, 1913.) Price 3 francs 50 centimes.

WRITTEN by well-known members of the French aeronautical professions, the book provides a simple and interesting account of the position of aviation at the present time. The text rarely deals quantitatively with the problems connected with the construction or motion of an aeroplane, calculations being left to notes at the end of the book; the notes occupy about one-third of the whole, and refer to investigations many of which are the original work of the authors.

Only a very short historical portion is provided as introduction, but it is interesting to find that the work of Sir George Cayley, as a pioneer in the development of the theory of the aeroplane, is prominently referred to. The "coming of the aeroplane" is dated from the autumn of 1908, when the flights of Farman, Delagrange, Blériot, and the striking achievements of the Wright Brothers began to attract attention; the subsequent rapid development of aviation and its causes are referred to and illustrated by means of a record of the best results obtained at successive stages.

A discussion of the flight of birds in winds, on the lines of Langley's "Internal work of the Wind," is used to illustrate the possibility of extracting energy from the wind, and so flying without the use of an engine.

Aeroplanes of various types, made in the period 1908–10, are illustrated, and the organs described in some detail. The use of the elevator and rudder in manœuvring is referred to under gliders, but stability, longitudinal and lateral, is referred to power-driven machines. Lateral stability is subdivided into "stability of gyration," that is, stability of direction relative to the wind and "lateral stability" in the limited sense of keeping an even keel. Bryan has shown that the subdivision may be misleading as the two are not independent, and should be treated together.

The book has the advantage of a very complete index, which makes reference a simple matter.

Household Bacteriology: For Students in Domestic Science. By Estelle D. Buchanan and Prof. R. E. Buchanan. Pp. xv+536. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 10*s*. net.

"DOMESTIC science" is rightly coming to the fore, and in any course of instruction devoted to this subject, some amount of bacteriology, or "microbiology," as it may preferably be termed, must be included. The present volume practically covers the ground of such knowledge of micro-organisms as is desirable for the domestic science student. It is divided into five sections, dealing respectively with (a) morphology and classification; (b) cultivation and methods of investigation; (c) physiology; (d) fermentation; and (e) micro-organisms in relation to health and disease. The bacteria, yeasts, and moulds are considered at some length, and a chapter on parasitic Protozoa is included.

The chapters on general morphology and classification are particularly good, and a clear account is furnished of the distinguishing features of the various groups. In an appendix an illustrated key is given of the families and genera of the common moulds; this will be found most useful in the laboratory by other than domestic science students.

The brief description of the optics of the immersion system of lenses is correct, so far as it goes, but a paragraph should have been inserted pointing out that the great advantage of this system is the increased resoluion obtained thereby.

The chapter on food preservation is a useful summary of the subject, but might have been extended with advantage.

The chapters on the nitrogen cycle in nature, alcoholic and other fermentations, enzyme action, and the ripening of certain foods are all satisfactory and convey a considerable amount of coordinated information on these important aspects of microbiology.

Much space (140 pages) is devoted to a consideration of disease and disease-producing micro-organisms, vegetable and protozoal. We think this section could have been somewhat curtailed with advantage, having regard to the avowed limitation of the book; and the space so gained might then have been devoted to a fuller consideration of certain aspects of household microbiology. Such criticisms as have been offered are those of detail, but the book as a whole is an excellent one. It is profusely and well illustrated, and can be strongly recommended not only to the domestic science student, but to a wider public.

R. T. Hewlett.

Aus Süd-Brasilien. Erinnerungen und Aufzeichnungen. By Dr. W. Breitenbach. Pp. xvi+251. (Brackwede i. W.: Dr. W. Breitenbach, 1913.) Price 3 marks.

The author has lived in southern Brazil for several years in order to observe the land and the people, especially the German colonies, and beginning in the year 1884, he has since described his observations in more than thirty newspaper articles, essays, and separate pamphlets. Considering the changes which have come about in Brazil within the last thirty years, this book does not pretend to deal with present-day questions of commerce, industry, and general development, or with the colonisation scheme, which, of course, has undergone complete modifications. His personal experiences, narratives of various journeys, are also omitted, having been described elsewhere. It is, therefore, not very obvious why these "reminiscences and notes" should be published now.

The fragmentary chapters on minerals, fauna, and flora are poor. Others, written in the easy, fluent style of feuilletons or causeries, deal with the life in towns, chiefly Porto Alegre, the capital of South Brazilian Germans, whose customs, modes of assimilation, ideals, and successes are compared with those of the Brazilians.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Branch Product in Actinium C.

It is now well established that the atoms of radium C and thorium C can break up in two distinct ways, *i.e.*, with the expulsion of either an α or a β particle. It is to be expected from the close analogy between the C products of the various radio-active families that actinium C should also show abnormal disintegration, and, further, it might be anticipated that one of the branch products would emit an α particle with great velocity and corresponding long range. We have made experiments to test this point. A source of actinium active deposit was covered with a sheet of mica equivalent to about 5 cm. air in stopping power of α particles, and the whole placed in an exhausted chamber with a zinc sulphide screen about 2 cm. from the source. The numbers of scintillations appearing on the screen per minute for different pressures of the air inside the apparatus were counted, and thus the falling off of the α particles with "range" determined. The results showed that in addition to the α particles of actinium C with range 5·4 cm., a small number, about 1 in 600, can penetrate as far as about 6·45 cm. Special experiments showed that the long-range α particles could not be due to radium or thorium impurity, and they must therefore be attributed to the expected new branch product.

In connection with this question, it should be noticed that Mme. Blanquies, in 1910, inferred the existence of two α-ray products in the active deposit of actinium from the shape of the Bragg ionisation curve. The small fraction of long-range α particles found in our experiments, viz., 1 in 600, is, however, quite insufficient to be reconciled with her results. We are therefore repeating her experiments.

E. Marsden.
R. H. Wilson.

University of Manchester, September 3.

The Terrestrial Distribution of the Radio-elements and the Origin of the Earth.

In Nature of June 19 and August 7, 1913, Mr. Holmes, in two interesting letters, shows on the basis of the planetesimal hypothesis how a concentration of the radio-elements might possibly take place in the earth's crust with their absence at depth to satisfactorily account for the observed temperature gradient of the earth; and in his latest communication he indicates how the inhibition of radio-activity by pressure might bring about the same result. But the terrestrial distribution of these elements seems to be of further importance in that it may enable us to determine whether our earth had a stellar or a planetesimal origin.

On the stellar hypothesis, the earth would be partly developed by a process of oxidation—practically the same as that by which we manufacture steel from impure cast-iron at the present day—and whereby all the impurities would be removed to the surface to form the primal crust. The first of this primal crust would be the most acidic, and the last the most basic; and in the metallic core left, even the oxygen which had been the means of removing all the impurities would itself be undetectable. Thorium is but a higher member of the silicon (carbon) family as uranium is of the oxygen family, and the conditions which remove the lower members should be effective in removing the higher ones also. So, too, it seems only natural that the most acidic rocks—that is, the rocks containing the greatest proportions of silicon and of oxygen—should at the same time be associated with the greatest proportions of thorium and of uranium, which are but the highest members of the silicon and oxygen families.

On the planetesimal hypothesis a similar distribution of the radio-elements can hardly be imagined. To get a metallic core that shall be free from thorium and uranium, we have to imagine the planetesimals undergoing individually the oxidation process which has just been sketched, unless the planetesimals happened to be fragments of a preformed stellar mass. Provided all went well, when these planetesimals were piling themselves together to form the earth, the result would be a metallic core free from thorium and uranium, but surrounded by a crust in which these elements would be uniformly distributed. As the acidic rocks differ only in degree from the basic rocks, it would be impossible for the former to rise up through miles of a mixture of both to form an acidic layer, as happens in the case of a stellar earth. Subsequent aqueous action is relatively negligible in both cases.

It is probably the exigencies of the planetesimal hypothesis that constrain Mr. Holmes to state that there is "clearly a marked antipathy between the radio-elements and native iron, for in all the terrestrial examples which have been examined uranium and thorium are barely detectable." As a matter of fact, these elements alloy with iron and nickel, which are the constituents of native iron; and their marked absence is a proof that native iron had undergone an oxidation process at one time in its history, and so had its thorium and uranium removed.

95 Bath Street, Glasgow. GEORGE CRAIG.

THE INTERNATIONAL UNION FOR SOLAR RESEARCH.

THE fifth conference of the International Union for Cooperation in Solar Research was held at Bonn, by invitation of Prof. Kayser, from July 31 to August 5. The attendance was about 100, including delegates from nearly every country in Europe, and a large contingent from America. In the absence of Prof. Hale and Dr. Schuster, through sickness, the executive committee was ably represented by Prof. Turner. As on former occasions, the chief business at the general meetings was to receive and discuss the reports of the various committees appointed for the organisation of observations and methods of reduction.

An important part of the work of the union has been that relating to standards of wave-length. At the last meeting, held at Mount Wilson, California, in 1910, it was believed that a final set of standards was well within sight, but further investigations have revealed unexpected difficulties. It has, in fact, been found by Goos and others that the wave-lengths of many of the iron lines vary slightly with the length of the arc and the portion of the arc observed. Fortunately, most of the lines already adopted as secondary standards, from interferometer determinations, preserve their positions under a variety of circumstances, but they are not sufficient in number. Hence, it has become necessary to attempt the definition of a standard iron arc for determinations of further standards, and for the production of reference spectra to be used in the determination of wave-lengths by interpolation. The committee recommended the following specification for the iron arc: (1) Length of arc, 6 mm. (2) For lines of wave-length greater than 4000, current to be 6 amperes, and for lines of shorter wave-length 4 amperes, or possibly less. (3) Direct current, positive pole above negative, P.D. of 220 volts, electrodes being iron rods of 7 mm. diameter. (4) An axial portion of the arc, at its middle, about 2 mm. in length, to be used as the source of light. Cooperation in the determination of tertiary standards is desired from all who possess concave gratings, plane gratings, or prisms of sufficient dispersion and resolving power, and to this end it is recommended that additional secondary standards be determined with the interformeter, so that the interpolation method may be used with greater exactness.

At the Mount Wilson meeting a committee on the determination of the solar rotation by means of the displacements of lines was formally organised, and a programme of research agreed upon. Each cooperating observer undertook observations, at specified latitudes, in a definite region of the spectrum, in addition to a control region common to all the observers, and lines were to be selected so as to include elements of widely different atomic weights. It now appears that different observers may obtain results differing systematically by as much as 10 per cent. from one another, and that serious discrepancies have also been found in the results obtained by different observers from measurements of the same photographs. The committee accordingly recommended that, before proceeding further, investigations of these sources of error should be made by determinations of velocity at the solar equator by as many different methods as possible.

Satisfactory progress in work with the spectroheliograph was reported, but the Committee hoped that additional observatories would install instruments of high dispersion, in order that filaments and alignments in the upper atmosphere might be more completely recorded. As the result of representations made by Prof. Ricco and by the Royal Astronomical Society, the title of the spectroheliograph committee was changed to "Committee on Solar Atmosphere," so as to include and unify all the observations on the solar atmosphere, visual and photographic, except those associated with eclipses. The organisation directed by Prof. Ricco, and other observers of prominences, were thus given the opportunity of closer connection with the union. After some discussion, a subcommittee for visual observations of prominences and related phenomena was appointed, with Prof.

Ricco as chairman and Father Cortie as secretary. The chief recommendations subsequently made by the sub-committee were that the limiting height of prominences for general statistical purposes should be 30″, and that results should be expressed as profile areas, the conventional "prominence unit" being defined as the area covered by an arc of 1 degree along the sun's limb and 1 second of arc of the celestial sphere in height. It is hoped that by this means it may be possible to combine more successfully the records made at different observatories.

From the report presented by the committee on the spectra of sun spots, it appears that spots observed during the recent minimum did not differ appreciably from those observed at maximum, so far as could be determined with instruments of moderate dispersion. It is, however, considered desirable that the systematic visual observations initiated by the committee should be continued at least until 1916, so as to include a complete cycle of eleven years. The organisation of photographic investigations of spot spectra has been undertaken, and several observers have already agreed to cooperate in preparing a much-needed catalogue of lines affected in spots, and also in other investigations.

An important outcome of the Mount Wilson meeting was the extension of the scope of the union so as to include astrophysics in general. The committee then appointed to consider the possibility of securing uniformity in the classification of stellar spectra has collected opinions from a great number of workers, and reports that a provisional preference for the Draper classification is nearly unanimous. At the same time, the general feeling is opposed to immediate committal to any system, and an effort will be made to secure the material necessary for the establishment of a classification that can be recommended for permanent and universal adoption.

The formal proceedings were varied by addresses and papers on subjects coming within the scope of the union, and by several interesting social gatherings. The receptions by the municipalities of Bonn and Cologne, and by Prof. and Frau Küstner at the Bonn Observatory, will long remain a pleasant memory to those who were privileged to be present, as will also the excursion on the Rhine generously provided by Prof. Kayser. The success of the conference as a whole was largely due to the admirable arrangements made by Profs. Kayser and Pflüger.

The next conference will be held at Rome in 1916.

A. Fowler.

THE BRITISH ASSOCIATION.

Arrangements for the Birmingham Meeting.

The meeting, which began on September 10 in Birmingham under the presidency of Sir Oliver Lodge, F.R.S., promises to be a large and important one. The number, both of local and of visiting members and associates, amounts at the time of writing to about 2600.

Among the corresponding and foreign representatives are:—Sir H. Angst (Consul-General, Zurich); Prof. Svante Arrhenius (Stockholm); Prof. Bemmelen (Groningen); Prof. H. Braus (Heidelberg); Prof. Capitan (Paris); Prof. Chodat (Geneva); Madame Curie (Paris); Dr. Dollo (Brussels); Prof. Lorentz (Leiden); Prof. Reinke (Kiel); Prof. Keibel (Freiburg); Dr. Versluys (Giessen); Dr. Gregory (New York); Prof. Pringsheim (Breslau); Prof. Sörensen (Copenhagen); and Prof. R. W. Wood (Baltimore). It is hoped that others may be able to attend the meeting.

A new procedure has been adopted this year with a view to reducing the pressure on the reception room during the first day or two of the meeting. To each intending visitor a "Selection Circular" has been addressed, giving a list of the various functions (addresses, discourses, entertainments, and excursions), which have been arranged, with a request that the functions selected should be indicated on the returned half of the circular. The response to this appeal has been very gratifying, as over fifteen hundred replies have already been received. Nevertheless, the work of the reception room officials has been very heavy.

The usual business meetings were held on Wednesday last. At the general committee a deputation from the Corporation and University of Manchester invited the Association to visit that city in 1915. The representatives present were: the Deputy Lord Mayor of Manchester, the Town Clerk, the Vice-Chancellor, Prof. Horace Lamb, F.R.S., Prof. H. B. Dixon, F.R.S., and Mr. Maxwell Garnett. In the evening the President delivered his long-expected address, the contents of which will now have become known.

On Thursday evening (September 11) the Lord Mayor and Lady Mayoress of Birmingham are holding a reception in the Council House Buildings, in which the new art gallery and natural history museum are lodged. Special loan collections have been deposited in the museum during the association week.

The University Degree Congregation takes place on the afternoon of September 11, and a fuller account will be given in our next issue. The list of graduands has been limited to a few distinguished men of science from abroad, representative mainly of the chief European nations. The following is the list of recipients of honorary degrees:—Madame Curie (Sorbonne. Paris), Prof. H. A. Lorentz (Leyden), Prof. Keibel (Freiburg), Prof. R. W. Wood (Baltimore), Prof. Svante Arrhenius (Stockholm). In the unavoidable absence of the chancellor, Mr. Joseph Chamberlain, Vice-Chancellor Barling conferred the honorary degree of LL.D. on the graduands, the ceremony in each case being prefaced by a presentation and speech made by the principal (Sir Oliver Lodge). After the ceremony the various departments of the New University Buildings were visited.

Entertainments and Excursions.

With regard to the entertainments: at the garden party given by Messrs. Cadbury Brothers at Bourneville on Friday, September 12, there will be a masque, folk-dancing, and choral singing by village children and workpeople. On Saturday a long list of excursions fills the bill, and an "Excursion Guide" giving full information of the route followed in each case, together with a full description of the several places to be visited, has been compiled by the chairman and secretary of the Excursions sub-committee (Mr. John Humphreys and Mr. F. B. Andrews), and is obtainable at the reception room; Stratford-on-Avon and Warwick, Coventry and Kenilworth, Worcester; Malvern; Banbury and Compton Wynyates; Lichfield and Wall; Droitwich and Hartlebury Castle, and the Arden villages are some of the chief points. In addition to the general excursions, some of the sections are arranging special visits for their members, particulars of which can be obtained in the reception room. On Saturday evening there will be a military concert and torchlight tattoo in the Botanical Gardens, Edgbaston.

On Sunday (September 14) there will be special services at the principal places of worship in the city. The Bishop of Birmingham is to preach in the Pro-Cathedral.

On Monday evening there will be three entertainments given by the local committee. The Prince of Wales Theatre will present the opera *Orpheus*, under the management of Herr Denhof. The Repertory Theatre will give St. John Hankin's *Return of the Prodigal*, and the New Street Picture House will exhibit films of historical and scientific interest.

Lectures.

The evening discourses take place on September 12 and September 16. The first will be given by Sir Henry Cunynghame, of the Home Office, and will deal experimentally with "Coal Dust Explosions and the Means of Preventing Them." The second—by Dr. Smith Woodward, F.R.S., of the British Museum (Natural History)—will be an illustrated exposition of "Missing Links among Extinct Animals." Both of these lectures will be delivered in the new Central Hall.

This year five "Citizens' Lectures" are to be given to (mainly) working-class audiences at the Digbeth Institute, Birmingham. They are not intended for members, but form an altogether independent scheme, provided partly by the association and partly by the local committee, with a view of interesting those members of the community who cannot join the association. The first lecture will be given by Dr. A. C. Haddon, F.R.S., on the decorative art of Savages. The other lectures are "The Panama Canal," by Dr. Vaughan Cornish, F.R.G.S.; "Recent Work on Heredity, and its Application to Man," by Dr. Leonard Doncaster; "Metals under the Microscope," by Dr. Walter Rosenhain, F.R.S.; and "The Evolution of Matter," by Mr. F. Soddy, F.R.S. The arrangements for these lectures have been entrusted to a committee, on which the Workers' Educational Association, the Birmingham Trades Council, the City Council, and other kindred bodies are represented. The demand for tickets has been very encouraging.

Sectional Proceedings.

A general statement of the addresses and of the chief papers to be delivered during the meeting has already been made public, and it is now only necessary to mention a few of the main topics of interest.

Section A (Physics and Mathematics) is naturally very strong this year, both from the fact that the president is a leading physicist, and also from the support which has been given to the sectional president, Dr. Baker, by the presence of distinguished colleagues, both from this country and from abroad. Among these may be mentioned Lord Rayleigh, Sir J. J. Thomson, Sir Joseph Larmor, Prof. Rutherford, and Prof. Bragg. Attention will be devoted especially to the subjects of radiation, radio-active emanations, and the structure of the atom. Prof. H. H. Turner will demonstrate a seismograph (which was one of the late Dr. Milne's instruments) to be erected in the basement of the University (Mason College). There will be a joint meeting with the Geographical Section on geodetic problems to be held on Tuesday morning, September 16.

The Chemical Section (B) meets in the Technical School. In addition to the usual programme, there will be a discussion on coal and coal-fuels on Monday morning (September 15), and another on radio-active elements and the periodic law on Tuesday, September 16; whilst on Friday morning (September 12) the two divisions of the section will discuss respectively the significance of optical properties of substances and certain problems in metallurgy.

The Geological Section (C) has a full programme, both of papers and excursions dealing with local problems in coal-mining, and in stratigraphical and palæontological geology. Special interest is exhibited in the address by Prof. Lapworth on the geology of the country round Birmingham.

The Zoological Section (Section D) is devoting Friday morning to a discussion on mimicry, the inheritance of melanism, and other problems of especial interest to entomologists, whilst on Monday morning the subject of "Convergence in the Mammalia" will be attractive to geologists, as well as to those distinguished zoologists who are to take a foremost part in the discussion. Many other papers of interest are promised, and on Monday afternoon at 3 p.m. Prof. Minchin is to give a special address on some aspects of sleeping sickness. We may here mention what promises to be one of the most important demonstrations and papers, namely, Prof. Benjamin Moore's "Synthesis of Organic Matter by Inorganic Colloids." This subject will be given jointly to Section D, Section K (Botany), and Section I (Physiology) on Tuesday morning at 10.45. Prof. Braus (of Heidelberg) will give a kinematograph exhibition that morning in the Picture House, New Street, of the development of the heart, and on Thursday afternoon there will be a joint excursion by a limited number (twenty-five) of members of each of the sections of Zoology, Botany, and Agriculture, respectively, to the Burbage Experimental

Station, when Major Hurst will demonstrate his Mendelian experiments.

The Economic Section has a well-organised discussion on inland waterways, to be opened by Lord Shuttleworth on Friday, September 12, and another on prices and the cost of living, on the Monday following. The subject of the "Panama Canal" will be discussed from many points of view, both by this section in the Queen's College, Paradise Street, and by the Engineering Section in the Technical School.

A large number of photographs of the Canal will be shown in the latter meeting room.

The Engineering Section has a full programme. In the Mechanical Sub-section Prof. Burstall has a paper on fuels that should attract attention; in the Electrical one there are contributions to the study of wireless telegraphy, and a paper on electric cooking. The transport and settlement of sand and sand-bars, and the re-construction of Snow Hill Station, Birmingham, are among the topics for discussion by the Mechanical Engineers. A gyroscope will be exhibited by Mr. J. W. Gordon.

Anthropology (Section H) has a long and interesting programme for each day, including Wednesday, September 17. The subject-matter, indeed, is so large and varied that in addition to the large meeting room in the Temperance Hall, Temple Street, a sub-section has been arranged to meet in the University (Mason College), Edmund Street. For details of the work of this section the daily programme must be consulted, and mention here can only be made of the joint discussion with the Education Section on the value of museums, to the report by Dr. Fleure and Mr. T. C. Jones on the ethnology of Wales; the papers by Dr. Flinders Petrie on Egyptian exploration; and to the paper on Palæolithic cave-paintings by Dr. Capitan, of Paris.

Section I (Physiology) suffers to some extent from the meeting during the past week of the International Congress of Physiologists at Groningen; but though many prominent men will thereby be prevented from attending the Birmingham meeting, an interesting debate on the physiology of reproduction is assured, and the psychologists have such a strong programme that their work is to form the basis for an independent sub-section, the problems of which are so closely allied to those of education that the meeting room of the sub-section is placed close to that of Education in the University (Mason College). A joint meeting of their two bodies will discuss "Research in Education" on Monday morning, September 15.

In the Botanical Section there will be, in addition to the usual programme of single papers (which include such interesting topics as "The Preservation of the British Flora" and "The Colours and Pigments of Flowers"), one or more joint discussions. On Friday morning, September 12, there will be a conference with the Agricultural Section on barley production, and probably a second on the fruit industry. The agriculturists are offering a paper on German forestry methods, by Prof. Fraser Storey, that is sure to appeal equally strongly to the Botanical Section.

Meetings devoted to topics of general interest form a distinctive feature of the Education Section. "The Educational Use of Museums" is the title of a discussion, which is strongly supported by the leading directors of our museums, whilst "The Function of the Modern University" is the subject for Friday's discussion. As this is introduced by Sir Alfred Hopkinson, and supported by such speakers as Lord Kenyon, Sir H. Reichel, Sir George Kenrick, Sir James Yoxall, and Miss Burstall, there is sure to be a large attendance.

Lastly, Agriculture (Section M) has a paper of outstanding interest, "The Partial Sterilisation of Soil by means of Caustic Lime," by Dr. Hutchinson and Mr. M. MacLennan, and gives the results of some striking experiments recently carried out at the Rothamsted Laboratory, Harpenden. Contributions from the same laboratory are: "The Relations between Protozoa and Soil-Problems," by Mr. T. Goodey (protozoologist to the University of Birmingham), and "The Weeds of Arable Land," by Dr. Brenchley. Prof. Sörensen will give an account of his recent investigations on cereals, whilst the economic side of agriculture will be represented by Sir Richard Paget's address on the possibilities of partnership between landlord and tenant.

Inaugural Address by Sir Oliver J. Lodge, D.Sc., LL.D., F.R.S., President.

Continuity.

Natura non vincitur nisi parendo.

First let me lament the catastrophe which has led to my occupying the chair here in this city. Sir William White was a personal friend of many here present, and I would that the citizens of Birmingham could have become acquainted with his attractive personality, and heard at first hand of the strenuous work which he accomplished in carrying out the behests of the Empire in the construction of its first line of defence.

Although a British Association address is hardly an annual stocktaking, it would be improper to begin this year of office without referring to three more of our losses: one that cultured gentleman, amateur of science in the best sense, who was chosen to preside over our jubilee meeting at York thirty-two years ago. Sir John Lubbock, first Baron Avebury, cultivated science in a spirit of pure enjoyment, treating it almost as one of the arts; and he devoted social and political energy to the welfare of the multitude of his fellows less fortunately situated than himself.

Through the untimely death of Sir George Darwin the world has lost a mathematical astronomer whose work on the tides and allied phenomena is a monument of power and achievement. So recently as our visit to South Africa he occupied the presidential chair.

By the third of our major losses, I mean the death of that brilliant mathematician of a neighbouring nation who took so comprehensive and philosophic a grasp of the intricacies of physics, and whose eloquent though sceptical exposition of our laws and processes, and of the modifications entailed in them by recent advances, will be sure to attract still more widespread attention among all to whom the rather abstruse subject-matter is sufficiently familiar. I cannot say that I find myself in agreement with all that Henri Poincaré wrote or spoke in the domain of physics, but no physicist can help being interested in his mode of presentation, and I may have occasion to refer, in passing, to some of the topics with which he dealt.

And now, eliminating from our purview, as is always necessary, a great mass of human activity, and limiting ourselves to a scrutiny on the side of pure science alone, let us ask what, in the main, is the characteristic of the promising though perturbing period in which we live. Different persons would give different answers, but the answer I venture to give is—rapid progress, combined with fundamental scepticism.

Rapid progress was not characteristic of the latter half of the nineteenth century—at least, not in physics. Fine solid dynamical foundations were laid, and the edifice of knowledge was consolidated; but wholly fresh ground was not being opened up, and totally new buildings were not expected.

"In many cases the student was led to believe that the main facts of nature were all known, that the chances of any great discovery being made by experiment were vanishingly small, and that therefore the experimentalist's work consisted in deciding between rival theories, or in finding some small residual effect, which might add a more or less important detail to the theory."—*Schuster.*

With the realisation of predicted æther waves in 1888, the discovery of X-rays in 1895, spontaneous radio-activity in 1896, and the isolation of the electron in 1898, expectation of further achievement became vivid; and novelties, experimental, theoretical, and speculative, have been showered upon us ever since this century began. That is why I speak of rapid progress.

Of the progress I shall say little; there must always be some uncertainty as to which particular achievement permanently contributes to it; but I will speak about the fundamental scepticism.

Let me hasten to explain that I do not mean the well-worn and almost antique theme of theological scepticism: that controversy is practically in abeyance just now. At any rate, the major conflict is suspended; the forts behind which the enemy has retreated do not invite attack; the territory now occupied by him is little more than his legitimate province. It is the scientific allies, now, who are waging a more or less invigorating conflict among themselves, with philosophers joining in. Meanwhile the ancient foe is biding his time and hoping that from the struggle something will emerge of benefit to himself. Some positions, he feels, were too hastily abandoned and may perhaps be retrieved; or, to put it without metaphor, it seems possible that a few of the things prematurely denied, because asserted on inconclusive evidence, may after all, in some form or other, have really happened. Thus the old theological bitterness is mitigated, and a temporising policy is either advocated or instinctively adopted.

To illustrate the nature of the fundamental scientific or philosophic controversies to which I do refer, would require almost as many addresses as there are sections of the British Association, or, at any rate as many as there are chief cities in Australia; and perhaps my successor in the chair will continue the theme; but, to exhibit my meaning very briefly, I may cite the kind of dominating controversies now extant, employing as far as possible only a single word in each case so as to emphasise the necessary brevity and insufficiency of the reference.

In physiology the conflict ranges round *Vitalism.* (My immediate predecessor dealt with the subject at Dundee.)

In chemistry the debate concerns *Atomic structure.* (My penultimate predecessor is well aware of pugnacity in that region.)

In biology the dispute is on the laws of *Inheritance.* (My nominated successor is likely to deal with this subject; probably in a way not deficient in liveliness.)

And besides these major controversies, debate is active in other sections:—

In education, *Curricula* generally are being overhauled or fundamentally criticised, and revolutionary ideas are promulgated concerning the advantages of freedom for infants.

In economic and political science, or sociology, what is there that is not under discussion? Not property alone, nor land alone, but everything—back to the garden of Eden and the inter-relations of men and women.

Lastly, in the vast group of mathematical and physical sciences, "slurred over rather than summed up as Section A," present-day scepticism concerns what, if I had to express it in one word, I should call *Continuity.* The full meaning of this term will hardly be intelligible without explanation, and I shall discuss it presently.

Still more fundamental and deep-rooted than any of these sectional debates, however, a critical examination of scientific foundations generally is going on; and a kind of philosophic scepticism is in the ascendant, resulting in a mistrust of purely intellectual processes and in a recognition of the limited scope of science.

For science is undoubtedly an affair of the intellect, it examines everything in the cold light of reason; and that is its strength. It is a commonplace to say that science must have no likes or dislikes, must aim only at truth; or as Bertrand Russell well puts it:—

"The kernel of the scientific outlook is the refusal to regard our own desires, tastes, and interests as affording a key to the understanding of the world."

This exclusive, single-eyed attitude of science is its strength; but, if pressed beyond the positive region of usefulness into a field of dogmatic negation and philosophising, it becomes also its weakness. For the nature of man is a large thing, and intellect is only a part of it: a recent part, too, which therefore necessarily, though not consciously, suffers from some of the defects of newness and crudity, and should refrain from imagining itself the whole—perhaps it is not even the best part—of human nature.

The fact is that some of the best things are, by abstraction, excluded from science, though not from literature and poetry; hence perhaps an ancient mistrust or dislike of science, typified by the Promethean legend. Science is systematised and *metrical* knowledge, and in regions where measurement cannot be applied it has small scope; or, as Mr. Balfour said the other day at the opening of a new wing of the National Physical Laboratory:—

"Science depends on measurement, and things not measurable are therefore excluded, or tend to be excluded, from its attention. But life and beauty and happiness are not measurable." And then characteristically he added: "If there could be a unit of happiness, politics might begin to be scientific."

Emotion and intuition and instinct are immensely older than science, and in a comprehensive survey of existence they cannot be ignored. Scientific men may rightly neglect them in order to do their proper work, but philosophers cannot.

So philosophers have begun to question some of the larger generalisations of science, and to ask whether in the effort to be universal and comprehensive we have not extended our laboratory inductions too far. The conservation of energy, for instance: is it always and everywhere valid; or may it under some conditions be disobeyed? It would seem as if the second law of thermodynamics must be somewhere disobeyed—at least, if the age of the universe is both ways infinite—else the final consummation would have already arrived.

Not by philosophers only, but by scientific men also, ancient postulates are being pulled up by the roots. Physicists and mathematicians are beginning to consider whether the long known and well established laws of mechanics hold true everywhere and always, or whether the Newtonian scheme must be replaced by something more modern, something to which Newton's laws of motion are but an approximation.

Indeed, a whole system of non-Newtonian mechanics has been devised, having as its foundation the recently discovered changes which must occur in bodies moving at speeds nearly comparable with that of light. It turns out, in fact, that both shape and mass are functions of velocity. As the speed increases the mass increases and the shape is distorted, though under ordinary conditions only to an infinitesimal extent.

So far I agree; I agree with the statement of fact; but I do not consider it so revolutionary as to overturn Newtonian mechanics. After all, a variation of mass is familiar enough, and it would be a great mistake to say that Newton's second law breaks down merely because mass is not constant. A raindrop is an example of variable mass; or the earth may be, by reason of meteoric dust; or the sun, by reason of radio-activity; or a locomotive, by reason of the emission of steam. In fact, variable masses are the commonest, for friction may abrade any moving body to a microscopic extent.

That mass is constant is only an approximation. That mass is equal to ratio of force and acceleration is a definition, and can be absolutely accurate. It holds perfectly even for an electron with a speed near that of light; and it is by means of Newton's second law that the variation of mass with velocity has been experimentally observed and compared with theory.

I urge that we remain with, or go back to, Newton. I see no reason against retaining all Newton's laws, discarding nothing, but supplementing them in the light of further knowledge.

Even the laws of geometry have been overhauled, and Euclidean geometry is seen to be but a special case of more fundamental generalisations. How far they apply to existing space, and how far time is a reality or an illusion, and whether it can in any sense depend on the motion or the position of an observer: all these things in some form or other are discussed.

The conservation of matter also, that main-mast of nineteenth-century chemistry, and the existence of the æther of space, that sheet-anchor of nineteenth-century physics—do they not sometimes seem to be going by the board?

Prof. Schuster, in his American lectures, commented on the modern receptive attitude as follows:—

"The state of plasticity and flux—a healthy state, in my opinion—in which scientific thought of the present day adapts itself to almost any novelty, is illustrated by the complacency with which the most cherished tenets of our fathers are being abandoned. Though it was never an article of orthodox faith that chemical elements were immutable and would not some day be resolved into simpler constituents, yet the conservation of mass seemed to lie at the very foundation of creation. But nowadays the student finds little to disturb him, perhaps too little, in the idea that mass changes with velocity; and he does not always realise the full meaning of the consequences which are involved."

This readiness to accept and incorporate new facts into the scheme of physics may have led to perhaps an undue amount of scientific scepticism, in order to right the balance.

But a still deeper variety of comprehensive scepticism exists, and it is argued that all our laws of nature, so laboriously ascertained and carefully formulated, are but conventions after all, not truths; that we have no faculty for ascertaining real truth; that our intelligence was not evolved for any such academic purpose; that all we can do is to express things in a form convenient for present purposes and employ that mode of expression as a tentative and pragmatically useful explanation.

Even *explanation*, however, has been discarded as too ambitious by some men of science, who claim only the power to describe. They not only emphasise the *how* rather than the *why*—as is in some sort inevitable, since explanations are never ultimate—but are satisfied with very abstract propositions, and regard mathematical equations as preferable to, because safer than, mechanical analogies or models.

"To use an acute and familiar expression of Gustav Kirchhoff, it is the object of science to *describe* natural phenomena, not to *explain* them. When we have expressed by an equation the correct relationship between different natural phenomena we have gone as far as we safely can, and if we go beyond we are entering on purely speculative ground."

But the modes of statement preferred by those who distrust our power of going directly into detail are far from satisfactory. Prof. Schuster describes and comments on them thus:—

"Vagueness, which used to be recognised as our great enemy, is now being enshrined as an idol to be worshipped. We may never know what constitutes atoms, or what is the real structure of the æther; why trouble, therefore, it is said, to find out more about them. Is it not safer, on the contrary, to confine ourselves to a general talk on entropy, luminiferous vectors, and undefined symbols expressing vaguely certain physical relationships? What really lies at the bottom of the great fascination which these new doctrines exert on the present generation is sheer cowardice; the fear of having its errors brought home to it." . . .

"I believe this doctrine to be fatal to a healthy development of science. Granting the impossibility of penetrating beyond the most superficial layers of observed phenomena, I would put the distinction between the two attitudes of mind in this way: One glorifies our ignorance, while the other accepts it as a regrettable necessity."

In further illustration of the modern sceptical attitude, I quote from Poincaré:—

"Principles are conventions and definitions in disguise. They are, however, deduced from experimental laws, and these laws have, so to speak, been erected into principles to which our mind attributes an absolute value. . . .

"The fundamental propositions of geometry, for instance Euclid's postulate, are only conventions; and it is quite as unreasonable to ask if they are true or false as to ask if the metric system is, true or false. Only, these conventions are convenient. . . .

"Whether the æther exists or not matters little—let us leave that to the metaphysicians; what is essential for us is that everything happens as if it existed, and that this hypothesis is found to be suitable for the explanation of phenomena. After all, have we any other reason for believing in the existence of material objects? That, too, is only a convenient hypothesis."

As an antidote against overpressing these utterances, I quote from Sir J. Larmor's preface:—

"There has been of late a growing trend of opinion, prompted in part by general philosophical views, in the direction that the theoretical constructions of physical science are largely factitious, that instead of presenting a valid image of the relations of things on which further progress can be based, they are still little better than a mirage. . . .

"The best method of abating this scepticism is to become acquainted with the real scope and modes of application of conceptions which, in the popular language of superficial exposition—and even in the unguarded and playful paradox of their authors, intended only for the instructed eye—often look bizarre enough."

One thing is very notable, that it is closer and more exact knowledge that has led to the kind of scientific scepticism now referred to; and that the simple laws on which we used to be working were thus simple and discoverable because the full complexity of existence was tempered to our ken by the roughness of our means of observation.

Kepler's laws are not accurately true, and if he had had before him all the data now available he could hardly have discovered them. A planet does not really move in an ellipse but in a kind of hypocycloid, and not accurately in that either.

So it is also with Boyle's law, and the other simple laws in physical chemistry. Even Van der Waals' generalisation of Boyle's law is only a further approximation.

In most parts of physics simplicity has sooner or later to give place to complexity; though certainly I urge that the simple laws were true, and are still true, as far as they go, their inaccuracy being only detected by further real discovery. The reason they are departed from becomes known to us; the law is not really disobeyed, but is modified through the action of a known additional cause. Hence it is all in the direction of progress.

It is only fair to quote Poincaré again, now that I am able in the main to agree with him:—

"Take, for instance, the laws of reflection. Fresnel established them by a simple and attractive theory which experiment seemed to confirm. Subsequently, more accurate researches have shown that this verification was but approximate; traces of elliptic polarisation were detected everywhere. But it is owing to the first approximation that the cause of these anomalies was found, in the existence of a transition layer; and all the essentials of Fresnel's theory have remained. We cannot help reflecting that all these relations would never have been noted if there had been doubt in the first place as to the complexity of the objects they connect. Long ago it was said: If Tycho had had instruments ten times as precise, we would never have had a Kepler, or a Newton, or astronomy. It is a misfortune for a science to be born too late, when the means of observation have become too perfect. That is what is happening at this moment with respect to physical chemistry; the founders are hampered in their general grasp by third and fourth decimal places; happily they are men of robust faith. As we get to know the properties of matter better we see that continuity reigns. . . . It would be difficult to justify [the belief in continuity] by apodeictic reasoning, but without [it] all science would be impossible."

Here he touches on my own theme, *Continuity*; for if we had to summarise the main trend of physical controversy at present, I feel inclined to urge that it largely turns on the question as to which way ultimate victory lies in the fight between continuity and discontinuity.

On the surface of nature at first we see discontinuity; objects detached and countable. Then we realise the air and other media, and so emphasise continuity and flowing quantities. Then we detect atoms and numerical properties, and discontinuity once more makes its appearance. Then we invent the æther and are impressed with continuity again. But this is not likely to be the end; and what the ultimate end will be, or whether there is an ultimate end, is a question difficult to answer.

The modern tendency is to emphasise the discontinuous or atomic character of everything. Matter has long been atomic, in the same sense as anthropology is atomic; the unit of matter is the atom, as the unit of humanity is the individual.[1] Whether men or women or children—they can be counted as so many "souls." And atoms of matter can be counted too.

Certainly, however, there is an illusion of continuity. We recognise it in the case of water. It appears to be a continuous medium, and yet it is certainly molecular. It is made continuous again, in a sense, by the æther postulated in its pores; for the æther is essentially continuous. Though Osborne Reynolds, it is true, invented a discontinuous or granular æther, on the analogy of the sea-shore. The sands of the sea, the hairs of the head, the descendants of a patriarch, are typical instances of numerable, or rather of innumerable things. The difficulty of enumerating them is not that there is nothing to count, but merely that the things to be counted are very numerous. So are the atoms in a drop of water—they outnumber the drops in an Atlantic Ocean—and, during the briefest time of stating their number, fifty millions or so may have evaporated; but they are as easy to count as the grains of sand on a shore.

The process of counting is evidently a process applicable to discontinuities, *i.e.*, to things with natural units; you can count apples and coins, and days and years, and people and atoms. To apply number to a continuum you must first cut it up into artificial units; and you are always left with incommensurable fractions. Thus only is it that you can deal numerically with such continuous phenomena as the warmth of a room, the speed of a bird, the pull of a rope, or the strength of a current.

But how, it may be asked, does discontinuity apply to number? The natural numbers, 1, 2, 3, &c., are discontinuous enough, but there are fractions to fill up the interstices; how do we know that they are not really connected by these fractions, and so made continuous again?

(By number I always mean commensurable number; incommensurables are not numbers: they are just what cannot be expressed in numbers. The square root of 2 is not a number, though it can be readily indicated by a length. Incommensurables are usual in physics and are frequent in geometry; the conceptions of geometry are essentially continuous. It is clear, as Poincaré says, that "if the points whose coordinates are commensurable were alone regarded as real, the in-circle of a square and the diagonal of the square would not intersect, since the coordinates of the points of intersection are incommensurable.")

I want to explain how commensurable fractions do not connect up numbers, nor remove their discontinuity in the least. The divisions on a foot rule, divided as closely as you please, represent commensurable fractions, but they represent none of the length. No matter how numerous they are, all the length lies between them; the divisions are mere partitions and have consumed none of it; nor do they connect up with each other, they are essentially discontinuous. The interspaces are infinitely more extensive than the barriers which partition them off from one another; they are like a row of compartments with infinitely thin walls. All the incommensurables lie in the inter-

[1] In his recent Canadian address, Lord Haldane emphasised the fact that though humanity is individually discontinuous it possesses a social and national continuity.

spaces; the compartments are full of them, and they are thus infinitely more numerous than the numerically expressible magnitudes. Take any point of the scale at random, that point will certainly lie in an interspace: it will not lie on a division, for the chances are infinity to 1 against it.

Accordingly incommensurable quantities are the rule in physics. Decimals do not in practice terminate or circulate; in other words, vulgar fractions do not accidentally occur in any measurements, for this would mean infinite accuracy. We proceed to as many places of decimals as correspond to the order of accuracy aimed at.

Whenever, then, a commensurable number is really associated with any natural phenomenon, there is necessarily a noteworthy circumstance involved in the fact, and it means something quite definite and ultimately ascertainable. Every discontinuity that can be detected and counted is an addition to knowledge. It not only means the discovery of natural units instead of being dependent on artificial ones, but it throws light also on the nature of phenomena themselves.

For instance:—

The ratio between the velocity of light and the inverted square root of the product of the electric and magnetic constants was discovered by Clerk Maxwell to be 1; and a new volume of physics was by that discovery opened.

Dalton found that chemical combination occurred between quantities of different substances specified by certain whole or fractional numbers; and the atomic theory of matter sprang into substantial though at first infantile existence.

The hypothesis of Prout, which in some modified form seems likely to be substantiated, is that all atomic weights are commensurable numbers; in which case there must be a natural fundamental unit underlying, and in definite groups composing, the atoms of every form of matter.

The small number of degrees of freedom of a molecule, and the subdivision of its total energy into equal parts corresponding thereto, is a theme not indeed without difficulty but full of importance. It is responsible for the suggestion that energy too may be atomic!

Mendelejeff's series again, or the detection of a natural grouping of atomic weights in families of seven, is another example of the significance of number.

Electricity was found by Faraday to be numerically connected with quantity of matter; and the atom of electricity began its hesitating but now brilliant career.

Electricity itself—*i.e.*, electric charge—strangely enough has proved itself to be atomic. There is a natural unit of electric charge, as suspected by Faraday and Maxwell and named by Johnstone Stoney. Some of the electron's visible effects were studied by Crookes in a vacuum; and its weighing and measuring by J. J. Thomson were announced to the British Association meeting at Dover in 1899—a fitting prelude to the twentieth century.

An electron is the natural unit of negative electricity, and it may not be long before the natural unit of positive electricity is found too. But concerning the nature of the positive unit there is at present some division into opposite camps. One school prefers to regard the unit of positive electricity as a homogeneous sphere, the size of an atom, in which electrons revolve in simple harmonic orbits and constitute nearly the whole effective mass. Another school, while appreciative of the simplicity and ingenuity and beauty of the details of this conception, and the skill with which it has been worked out, yet thinks the evidence more in favour of a minute central positive nucleus, or nucleus-group, of practically atomic mass; with electrons, larger—*i.e.* less concentrated—and therefore less massive than itself, revolving round it in astronomical orbits. While from yet another point of view it is insisted that positive and negative electrons can only differ skew-symmetrically, one being like the image of the other in a mirror, and that the mode in which they are grouped to form an atom remains for future discovery. But no one doubts that electricity is ultimately atomic.

Even magnetism has been suspected of being atomic, and its hypothetical unit has been named in advance the *magneton*; but I confess that here I have not been shaken out of the conservative view.

We may express all this as an invasion of number into unsuspected regions.

Biology may be said to be becoming atomic. It has long had natural units in the shape of cells and nuclei, and some discontinuity represented by body-boundaries and cell-walls; but now, in its laws of heredity as studied by Mendel, number and discontinuity are strikingly apparent among the reproductive cells, and the varieties of offspring admit of numerical specification and prediction to a surprising extent; while modification by continuous variation, which seemed to be of the essence of Darwinism, gives place to, or at least is accompanied by, mutation, with finite and considerable and in appearance discontinuous change.

So far from Nature not making jumps, it becomes doubtful if she does anything else. Her hitherto placid course, more closely examined, is beginning to look like a kind of steeplechase.

Yet undoubtedly continuity is the backbone of evolution, as taught by all biologists—no artificial boundaries or demarcations between species—a continuous chain of heredity from far below the amœba up to man. Actual continuity of undying germ-plasm, running through all generations, is taught likewise; though a strange discontinuity between this persistent element and its successive accessory body-plasms—a discontinuity which would convert individual organisms into mere temporary accretions or excretions, with no power of influencing or conveying experience to their generating cells—is advocated by one school.

Discontinuity does not fail to exercise fascination even in pure mathematics. Curves are invented which have no tangent or differential coefficient, curves which consist of a succession of dots or of twists; and the theory of commensurable numbers seems to be exerting a dominance over philosophic mathematical thought as well as over physical problems.

And not only these fairly accepted results are prominent, but some more difficult and unexpected theses in the same direction are being propounded, and the atomic character of *energy* is advocated. We had hoped to be honoured by the presence of Prof. Planck, whose theory of the *quantum*, or indivisible unit or atom of energy, excites the greatest interest, and by some is thought to hold the field.

Then again radiation is showing signs of becoming atomic or discontinuous. The corpuscular theory of radiation is by no means so dead as in my youth we thought it was. Some radiation is certainly corpuscular, and even the ethereal kind shows indications, which may be misleading, that it is spotty, or locally concentrated into points, as if the wave-front consisted of detached specks or patches; or as J. J. Thomson says, "the wave-front must be more analogous to bright specks on a dark ground than to a uniformly illuminated surface," thus suggesting that the æther may be fibrous in structure, and that a wave runs along lines of electric force; as the genius of Faraday surmised might be possible, in his "Thoughts on Ray Vibrations." Indeed, Newton guessed something of the same kind, I fancy, when he superposed ether-pulses on his corpuscles.

Whatever be the truth in this matter, a discussion on radiation, of extreme weight and interest, though likewise of great profundity and technicality, is expected on Friday in Section A. We welcome Prof. Lorentz, Dr. Arrhenius, Prof. Langevin, Prof. Pringsheim, Prof. R. W. Wood, and others, some of whom have been specially invited to England because of the important contributions which they have made to the subject-matter of this discussion.

Why is so much importance attached to radiation? Because it is the best-known and longest-studied link between matter and æther, and the only property we are acquainted with that affects the unmodified great mass of æther alone. Electricity and magnetism are associated with the modifications or singularities called electrons; most phenomena are connected still more directly with matter. Radiation, however, though excited by an accelerated electron, is subsequently let loose in the æther of space, and travels as a definite thing at a measurable and constant pace—a pace independent of everything so long as the æther is free, unmodified and unloaded by matter. Hence radiation has much to teach us, and we have much to learn concerning its nature.

How far can the analogy of granular, corpuscular, countable, atomic, or discontinuous things be pressed? There are those who think it can be pressed very far. But to avoid misunderstanding, let me state, for what it may be worth, that I myself am an upholder of *ultimate* Continuity, and a fervent believer in the æther of space.

We have already learnt something about the æther; and although there may be almost as many varieties of opinion as there are people qualified to form one, in my view we have learnt as follows:

The æther is the universal connecting medium which binds the universe together, and makes it a coherent whole instead of a chaotic collection of independent isolated fragments. It is the vehicle of transmission of all manner of force, from gravitation down to cohesion and chemical affinity; it is therefore the storehouse of potential energy.

Matter moves, but æther is strained.

What we call elasticity of matter is only the result of an alteration of configuration due to movement and readjustment of particles, but all the strain and stress are in the æther. The æther itself does not move, that is to say it does not move in the sense of locomotion, though it is probably in a violent state of rotational or turbulent motion in its smallest parts; and to that motion its exceeding rigidity is due.

As to its density, it must be far greater than that of any form of matter, millions of times denser than lead or platinum. Yet matter moves through it with perfect freedom, without any friction or viscosity. There is nothing paradoxical in this: viscosity is not a function of density; the two are not necessarily connected. When a solid moves through an alien fluid it is true that it acquires a spurious or apparent extra inertia from the fluid it displaces; but, in the case of matter and æther, not only is even the densest matter excessively porous and discontinuous, with vast interspaces in and among the atoms, but the constitution of matter is such that there appears to be no displacement in the ordinary sense at all; the æther is itself so modified as to *constitute* the matter in some way. Of course, that portion moves, its inertia is what we observe, and its amount depends on the potential energy in its associated electric field, but the motion is not like that of a foreign body, it is that of some inherent and merely individualised portion of the stuff itself. Certain it is that the æther exhibits no trace of viscosity.[2]

Matter in motion, æther under strain, constitute the fundamental concrete things we have to do with in physics. The first pair represent kinetic energy, the second potential energy; and all the activities of the material universe are represented by alternations from one of these forms to the other.

Whenever this transference and transformation of energy occur, work is done, and some effect is produced, but the energy is never diminished in quantity: it is merely passed on from one body to another, always from æther to matter, or *vice versâ*—except in the case of radiation, which simulates matter—and from one form to another.

The forms of energy can be classified as either a translation, a rotation, or a vibration of pieces of matter of different sizes, from stars and planets down to atoms and electrons; or else an æthereal strain which in various different ways is manifested by the behaviour of such masses of matter as appeal to our senses.[3]

Some of the facts responsible for the suggestion that energy is atomic seem to me to depend on the discontinuous nature of the structure of a material atom, and on the high velocity of its constituent particles. The apparently discontinuous emission of radiation is, I believe, due to features in the real discontinuity of matter. Disturbances inside an atom appear to be essentially catastrophic; a portion is liable to be ejected with violence. There appears to be a critical velocity below which ejection does not take place; and, when it does, there also occurs a sudden rearrangement of parts which is presumably responsible for some perceptible æthereal radiation. Hence it is, I suppose, that radiation comes off in gushes or bursts; and hence it appears to consist of indivisible units. The occasional phenomenon of new stars, as compared with the steady orbital motion of the millions of recognised bodies, may be suggested as an astronomical analogue.

The hypothesis of *quanta* was devised to reconcile the law that the energy of a group of colliding molecules must in the long run be equally shared among all their degrees of freedom, with the observed fact that the energy is really shared into only a small number of equal parts. For if vibration-possibilities have to be taken into account, the number of degrees of molecular freedom must be very large, and energy shared among them ought soon to be all frittered away; whereas it is not. Hence the idea is suggested that minor degrees of freedom are initially excluded from sharing the energy, because they cannot be supplied with less than one atom of it.

I should prefer to express the fact by saying that the ordinary encounters of molecules are not of a kind able to excite atomic vibrations, or in any way to disturb the æther. Spectroscopic or luminous vibrations of an atom are excited only by an exceptionally violent kind of collision, which may be spoken of as chemical clash; the ordinary molecular orbital encounters, always going on at the rate of millions a second, are ineffective in that respect, except in the case of phosphorescent or luminescent substances. That common molecular deflections *are* ineffective is certain, else all the energy would be dissipated or transferred from matter into the æther; and the reasonableness of their radiative inefficiency is not far to seek, when we consider the comparatively leisurely character of molecular movements, at speeds comparable with the velocity of sound. Admittedly, how-

[2] For details of my experiment on this subject see Phil. Trans. Roy. Soc. for 1893 and 1897; or a very abbreviated reference to it, and to the other matters above-mentioned, in my small book "The Ether of Space."

[3] See, in the Philosophical Magazine for 1879, my article on a classification of the forms of energy.

ever, the effective rigidity of molecules must be complete, otherwise the sharing of energy must ultimately occur. They do not seem able to be set vibrating by anything less than a certain minimum stimulus; and that is the basis for the theory of *quanta*.

Quantitative applications of Planck's theory, to elucidate the otherwise shaky stability of the astronomically constituted atom, have been made; and the agreement between results so calculated and those observed, including a determination of series of spectrum lines, is very remarkable. One of the latest contributions to this subject is a paper by Dr. Bohr in *The Philosophical Magazine* for July this year.

To show that I am not exaggerating the modern tendency towards discontinuity, I quote, from M. Poincaré's "Dernières Pensées," a proposition which he announces in italics as representing a form of Prof. Planck's view of which he apparently approves:—

"A physical system is susceptible of a finite number only of distinct conditions; it jumps from one of these conditions to another without passing through a continuous series of intermediate conditions."

Also this from Sir Joseph Larmor's preface to Poincaré's "Science and Hypothesis":—

"Still more recently it has been found that the good Bishop Berkeley's logical jibes against the Newtonian ideas of fluxions and limiting ratios cannot be adequately appeased in the rigorous mathematical conscience, until our apparent continuities are resolved mentally into discreet aggregates which we only partially apprehend. The irresistible impulse to atomise everything thus proves to be not merely a disease of the physicist: a deeper origin, in the nature of knowledge itself, is suggested."

One very valid excuse for the prevalent attitude is the astonishing progress that has been made in actually seeing or almost seeing the molecules, and studying their arrangement and distribution.

The laws of gases have been found to apply to emulsions and to fine powders in suspension, of which the Brownian movement has long been known. This movement is caused by the orthodox molecular bombardment, and its average amplitude exactly represents the theoretical mean free path calculated from the "molecular weight" of the relatively gigantic particles. The behaviour of these microscopically visible masses corresponds closely and quantitatively with what could be predicted for them as fearfully heavy atoms, on the kinetic theory of gases; they may indeed be said to constitute a gas with a gram-molecule as high as 200,000 tons; and, what is rather important as well as interesting, they tend visibly to verify the law of equipartition of energy even in so extreme a case, when that law is properly stated and applied.

Still more remarkable—the application of X-rays to display the arrangement of molecules in crystals, and ultimately the arrangement of atoms in molecules, as initiated by Prof. Laue with Drs. Friedrich and Knipping, and continued by Prof. Bragg and his son and by Dr. Tutton, constitute a series of researches of high interest and promise. By this means many of the theoretical anticipations of our countryman, Mr. William Barlow, and—working with him—Prof. Pope, as well as of those distinguished crystallographers von Groth and von Fedorow, have been confirmed in a striking way. These brilliant researches, which seem likely to constitute a branch of physics in themselves, and which are being continued by Messrs. Moseley and C. G. Darwin, and by Mr. Keene and others, may be called an apotheosis of the atomic theory of matter.

One other controversial topic I shall touch upon in the domain of physics, though I shall touch upon it lightly, for it is not a matter for easy reference as yet. If the *Principle of Relativity* in an extreme sense establishes itself, it seems as if even *time* would become discontinuous and be supplied in atoms, as money is doled out in pence or centimes instead of continuously; in which case our customary existence will turn out to be no more really continuous than the events on a kinematograph screen, while that great agent of continuity, the æther of space, will be relegated to the museum of historical curiosities.

In that case differential equations will cease to represent the facts of nature, they will have to be replaced by finite differences, and the most fundamental revolution since Newton will be inaugurated.

Now in all the debateable matters of which I have indicated possibilities I want to urge a conservative attitude. I accept the new experimental results on which some of these theories—such as the principle of relativity—are based, and am profoundly interested in them, but I do not feel that they are so revolutionary as their propounders think. I see a way to retain the old and yet embrace the new, and I urge moderation in the uprooting and removal of landmarks.

And of these the chief is Continuity. I cannot imagine the exertion of mechanical force across empty space, no matter how minute; a continuous medium seems to me essential. I cannot admit discontinuity in either space or time, nor can I imagine any sort of experiment which would justify such a hypothesis. For surely we must realise that we know nothing experimental of either space or time, we cannot modify them in any way. We make experiments on bodies, and only on bodies, using "body" as an exceedingly general term.

We have no reason to postulate anything but continuity for space and time. We cut them up into conventional units for convenience' sake, and those units we can count; but there is really nothing atomic or countable about the things themselves. We can count the rotations of the earth, or the revolutions of an electron, or the vibrations of a pendulum, or the waves of light. All these are concrete and tractable physical entities; but space and time are ultimate data, abstractions based on experience. We know them through motion, and through motion only, and motion is essentially continuous. We ought clearly to discriminate between things themselves and our mode of measuring them. Our measures and perceptions may be affected by all manner of incidental and trivial causes, and we may get confused or hampered by our own movement; but there need be no such complication in things themselves, any more than a landscape is distorted by looking at it through an irregular window-pane or from a travelling coach. It is an ancient and discarded fable that complications introduced by the motion of an observer are real complications belonging to the outer universe.

Very well, then, what about the æther, is that in the same predicament? Is that an abstraction, or a mere convention, or is it a concrete physical entity on which we can experiment?

Now it has to be freely admitted that it is exceedingly difficult to make experiments on the æther. It does not appeal to sense, and we know no means of getting hold of it. The one thing we know metrical about it is the velocity with which it can transmit transverse waves. That is clear and definite, and thereby to my judgment it proves itself a physical agent; not, indeed, tangible or sensible, but yet concretely real.

But it does elude our laboratory grasp. If we rapidly move matter through it, hoping to grip it and move it too, we fail; there is no mechanical connection. And even if we experiment on light, we fail too. So long as transparent matter is moving relatively to us, light can be affected inside that matter; but when matter is relatively stationary to matter nothing observable takes place, however fast things may be moving, so long as they move together.

Hence arises the idea that motion with respect to æther is meaningless; and the fact that only relative motion of pieces of matter with respect to each other has so far been observed is the foundation of the principle of relativity. It sounds simple enough as thus stated, but in its developments it is an ingenious and complicated doctrine embodying surprising consequences which have been worked out by Prof. Einstein and his disciples with consummate ingenuity.

What have I to urge against it? Well, in the first place, it is only in accordance with common sense that no effect of the first order can be observed without relative motion of matter. An æther-stream through our laboratories is optically and electrically undetectable, at least as regards first-order observation; this is clearly explained for general readers in my book, "The Ether of Space," chapter iv. But the principle of relativity says more than that; it says that no effect of any order of magnitude can ever be observed without the relative motion of matter.

The truth underlying this doctrine is that absolute motion without reference to *anything* is unmeaning. But the narrowing down of "anything" to mean any piece of matter is illegitimate. The nearest approach to absolute motion that we can physically imagine is motion through or with respect to the æther of space. It is natural to assume that the æther is on the whole stationary, and to use it as a standard of rest; in that sense motion with reference to it may be called absolute, but in no other sense.

The principle of relativity claims that we can never ascertain such motion: in other words it practically or pragmatically denies the existence of the æther. Every one of our scientifically observed motions, it says, are of the same nature as our popularly observed ones, viz. motion of pieces of matter relatively to each other; and that is all that we can ever know. Everything goes on—says the principle of relativity—as if the æther did not exist.

Now the facts are that no motion with reference to the æther alone has ever yet been observed: there are always curious compensating effects which just cancel out the movement-terms and destroy or effectively mask any phenomenon that might otherwise be expected. When matter moves past matter observation can be made; but, even so, no consequent locomotion of æther, outside the actually moving particles, can be detected.

(It is sometimes urged that rotation is a kind of absolute motion that can be detected, even in isolation. It can so be detected, as Newton pointed out; but in cases of rotation matter on one side the axis is moving in the opposite direction to matter on the other side of the axis; hence rotation involves relative material motion, and therefore can be observed.)

To detect motion through æther we must use an æthereal process. We may use radiation, and try to compare the speeds of light along or across the motion, or we might try to measure the speed, first with the motion and then against it. But how are we to make the comparison? If the time of emission from a distant source is given by a distant clock, that clock must be observed through a telescope, that is by a beam of light; which is plainly a compensating process. Or the light from a neighbouring source can be sent back to us by a distant mirror; when again there will be compensation. Or the starting of light from a distant terrestrial source may be telegraphed to us, either with a wire or without; but it is the æther that conveys the message in either case, so again there will be compensation. Electricity, magnetism, and light, are all effects of the æther.

Use cohesion, then; have a rod stretching from one place to another, and measure that. But cohesion is transmitted by the æther too, if, as believed, it is the universal binding medium. Compensation is likely; compensation can, on the electrical theory of matter, be predicted.

Use some action not dependent on æther, then. Very well, where shall we find it?

To illustrate the difficulty I will quote a sentence from Sir Joseph Larmor's paper before the International Congress of Mathematicians at Cambridge last year:—

"If it is correct to say with Maxwell that all radiation is an electrodynamic phenomenon, it is equally correct to say with him that all electrodynamic relations between material bodies are established by the operation, on the molecules of those bodies, of fields of force which are propagated in free space as radiation and in accordance with the laws of radiation, from one body to the other."

The fact is, we are living in an epoch of some very comprehensive generalisations. The physical discovery of the twentieth century, so far, is the electrical theory of matter. This is the great new theory of our time; it was referred to, in its philosophical aspect, by Mr. Balfour in his presidential address at Cambridge in 1904. We are too near it to be able to contemplate it properly; it has still to establish itself and to develop in detail, but I anticipate that in some form or other it will prove true.[4]

Here is a briefest possible summary of the first chapter (so to speak) of the electrical theory of matter:—

(1) Atoms of matter are composed of electrons—of positive and negative electric charges.

(2) Atoms are bound together into molecules by chemical affinity which is intense electrical attraction at ultra-minute distances.

(3) Molecules are held together by cohesion, which I for one regard as residual or differential chemical affinity over molecular distances.

(4) Magnetism is due to the locomotion of electrons. There is no magnetism without an electric current, atomic or otherwise. There is no electric current without a moving electron.

(5) Radiation is generated by every accelerated electron, in amount proportional to the square of its acceleration; and there is no other kind of radiation, except indeed a corpuscular kind; but this depends on the velocity of electrons and therefore again can only be generated by their acceleration.

The theory is bound to have curious consequences; and already it has contributed to some of the uprooting and uncertainty that I speak of. For, if it be true, every material interaction will be electrical, *i.e.* æthereal; and hence arises our difficulty. Every kind of force is transmitted by the æther, and hence, so long as all our apparatus is travelling together at one and the same pace, we have no chance of detecting the motion. That is the strength of the principle of relativity. The changes are not zero, but they cancel each other out of observation (NATURE, vol. xlvi., p. 165, 1892).

Many forms of statement of the famous Michelson-Morley experiment are misleading. It is said to prove that the time taken by light to go with the æther stream is the same as that taken to go against or across it. It does not show that. What it shows is that the time taken by light to travel to and fro

4 For a general introductory account of the electrical theory of matter my Romanes lecture for 1903 (Clarendon Press) may be referred to.

on a measured interval fixed on a rigid block of matter is independent of the aspect of that block with respect to any motion of the earth through space. A definite and most interesting result: but it may be, and often is, interpreted loosely and too widely.

It is interpreted too widely, as I think, when Prof. Einstein goes on to assume that no non-relative motion of matter can be ever observed even when *light* is brought into consideration. The relation of light to matter is very curious. The wave front of a progressive wave simulates many of the properties of matter. It has energy, it has momentum, it exerts force, it sustains reaction. It has been described as a portion of the mass of a radiating body—which gives it a curiously and unexpectedly corpuscular "feel." But it has a definite velocity. Its velocity in space relative to the æther is an absolute constant independent of the motion of the source. This would not be true for corpuscular light.

Hence I hold that here is something with which our own motion may theoretically be compared; and I predict that our motion through the æther will some day be detected by help of this very fact—by comparing our speed with that of light: though the old astronomical aberration, which seemed to make the comparison easy, failed to do so quite simply, because it is complicated by the necessity of observing the position of a distant source, in relation to which the earth is moving. If the source and observer are moving together there is no possibility of observing aberration. Nevertheless, I maintain that when matter is moving near a beam of light we may be able to detect the motion. For the velocity of light in space is no function of the velocity of the source, nor of matter near it; it is quite unaffected by source or receiver. Once launched it travels in its own way. If we are travelling to meet it, it will be arriving at us more quickly; if we travel away from it, it will reach us with some lag. And observation of the acceleration or retardation is made by aid of Jupiter's satellites. We have there the dial of a clock, to or from which we advance or recede periodically. It gains while we approach it, it loses while we recede from it, it keeps right time when we are stationary or only moving across the line of sight.

But then, of course, it does not matter whether Jupiter is standing still and we are moving, or *vice versâ*: it is a case of relative motion of matter again. So it is if we observe a Doppler effect from the right- and left-hand limbs of the rotating sun. True, and if we are to permit no relative motion of matter we must use a terrestrial source, clamped to the earth as our receiver is. And now we shall observe nothing.

But not because there is nothing to observe. Lag must really occur if we are running away from the light, even though the source is running after us at the same pace; unless we make the assumption—true only for corpuscular light—that the velocity of light is not an absolute thing, but is dependent on the speed of the source. With corpuscular light there is nothing to observe; with wave light there is something, but we cannot observe it.

But if the whole solar system is moving through the æther I see no reason why the relative æther drift should not be observed by a differential residual effect in connection with Jupiter's satellites or the right and left limbs of the sun. The effect must be too small to observe without extreme precision, but theoretically it ought to be there. Inasmuch, however, as relative motion of matter with respect to the observer is involved in these effects, it may be held that the detection of a uniform drift of the solar system in this way is not contrary to the principle of relativity. It is contrary to some statements of that principle; and the cogency of those statements breaks down, I think, whenever they include the velocity of light; because there we really have something absolute (in the only sense in which the term can have a physical meaning) with which we can compare our own motions, when we have learnt how.

But in ordinary astronomical translation—translation as of the earth in its orbit—all our instruments, all our standards, the whole contents of our laboratory, are moving at the same rate in the same direction; under those conditions we cannot expect to observe anything. Clerk Maxwell went so far as to say that if every particle of matter simultaneously received a graduated blow so as to produce a given constant acceleration all in the same direction, we should be unaware of the fact. He did not then know all that we know about radiation. But apart from that, and limiting ourselves to comparatively slow changes of velocity, our standards will inevitably share whatever change occurs. So far as observation goes, everything will be practically as if no change had occurred at all; though that may not be the truth. All that experiment establishes is that there have so far always been compensations; so that the attempt to observe motion through the æther is being given up as hopeless.

Surely, however, the minute and curious compensations cannot be accidental, they must be necessary? Yes, they are necessary; and I want to say why. Suppose the case were one of measuring thermal expansion; and suppose everything had the same temperature and the same expansibility; our standards would contract or expand with everything else, and we could observe nothing; but expansion would occur nevertheless. That is obvious, but the following assertion is not so obvious. If everything in the Universe had the same temperature, no matter what that temperature was, nothing would be visible at all; the external world, so far as vision went, would not appear to exist. Visibility depends on radiation, on differential radiation. We must have differences to appeal to our senses, they are not constructed for uniformity.

It is the extreme omnipresence and uniformity and universal agency of the æther of space that makes it so difficult to observe. To observe anything you must have differences. If all actions at a distance are conducted at the same rate through the æther, the travel of none of them can be observed. Find something not conveyed by the æther, and there is a chance. But then every physical action is transmitted by the æther, and in every case by means of its transverse or radiation-like activity.

Except perhaps Gravitation. That may give us a clue some day, but at present we have not been able to detect its speed of transmission at all. No plan has been devised for measuring it. Nothing short of the creation or destruction of matter seems likely to serve: creation or destruction of the gravitational unit, whether it be an atom or an electron, or whatever it is. Most likely the unit of weight is an electron, just as the unit of mass is.

The so-called non-Newtonian Mechanics, with mass and shape a function of velocity, is an immediate consequence of the electrical theory of matter. The dependence of inertia and shape on speed is a genuine discovery, and, I believe, a physical fact. The Principle of Relativity would reduce it to a conventional fiction. It would seek to replace this real change in matter by imaginary changes in time. But surely we must admit that Space and Time are essentially unchangeable: they are not at the disposal even of mathematicians; though it is true that Pope Gregory, or a Daylight-saving Bill, can play with our units, can turn the 3rd of October in any one year into the

14th, or can make the sun South sometimes at eleven o'clock sometimes at twelve.[5]

But the changes of dimension and mass due to velocity are not conventions but realities; so I urge, on the basis of the electrical theory of matter. The Fitzgerald-Lorentz hypothesis I have an affection for. I was present at its birth. Indeed, I assisted at its birth; for it was in my study at 21 Waverley Road, Liverpool, with Fitzgerald in an armchair, and while I was enlarging on the difficulty of reconciling the then new Michelson experiment with the theory of astronomical aberration and with other known facts, that he made his brilliant surmise:—"Perhaps the stone slab was affected by the motion." I rejoined that it was a 45° shear that was needed. To which he replied, "Well, that's all right—a simple distortion." And very soon he said, "And I believe it occurs, and that the Michelson experiment demonstrates it." A shortening long-ways, or a lengthening cross-ways would do what was wanted.

And is such a hypothesis gratuitous? Not at all: in the light of the electrical theory of matter such an effect ought to occur. The amount required by the experiment, and given by the theory, is equivalent to a shrinkage of the earth's diameter by rather less than three inches, in the line of its orbital motion through the æther of space. An oblate spheroid with the proper eccentricity has all the simple geometrical properties of a stationary sphere; the eccentricity depends in a definite way on speed, and becomes considerable as the velocity of light is approached.

All this Profs. Lorentz and Larmor very soon after, and quite independently, perceived; though this is only one of the minor achievements in the electrical theory of matter which we owe to our distinguished visitor Prof. H. A. Lorentz.

The key of the position, to my mind, is the nature of cohesion. I regard cohesion as residual chemical affinity, a balance of electrical attraction over repulsion between groups of alternately charged molecules. Lateral electrical attraction is diminished by motion; so is lateral electric repulsion. In cohesion both are active, and they nearly balance. At anything but molecular distance they quite balance, but at molecular distance attraction predominates. It is the diminution of the predominant partner that will be felt. Hence while longitudinal cohesion, or cohesion in the direction of motion, remains unchanged, lateral cohesion is less; so there will be distortion, and a unit cube x, y, z moving along x with velocity u becomes a parallelopiped with sides $1/k^2, k, k$; where $1/k^6 = 1 - u^2/v^2$.[6]

The electrical theory of matter is a positive achievement, and has positive results. By its aid we make experiments which throw light upon the relation between matter and the æther of space. The principle of relativity, which seeks to replace it, is a principle of negation, a negative proposition, a statement that observation of certain facts can never be made, a denial of any relation between matter and æther, a virtual denial that the æther exists. Whereas if we admit the real changes that go on by reason of rapid motion, a whole field is open for discovery; it is even possible to investigate the changes in shape of an electron—appallingly minute though it is—as it approaches the speed of light; and properties belonging to the æther of space, evasive though it be, cannot lag far behind.

Speaking as a physicist, I must claim the æther as peculiarly our own domain. The study of molecules we share with the chemist, and matter in its various forms is investigated by all men of science, but a study of the æther of space belongs to physics only. I am not alone in feeling the fascination of this portentous entity. Its curiously elusive and intangible character, combined with its universal and unifying permeance, its apparently infinite extent, its definite and perfect properties, make the æther the most interesting, as it is by far the largest and most fundamental, ingredient in the material cosmos.

As Sir J. J. Thomson said at Winnipeg—

"The æther is not a fantastic creation of the speculative philosopher; it is as essential to us as the air we breathe. . . . The study of this all-pervading substance is perhaps the most fascinating and important duty of the physicist."

Matter it is not, but material it is; it belongs to the material universe, and is to be investigated by ordinary methods. But to say this is by no means to deny that it may have mental and spiritual functions to subserve in some other order of existence, as matter has in this.

The æther of space is at least the great engine of continuity. It may be much more, for without it there could hardly be a material universe at all. Certainly, however, it is essential to continuity; it is the one all-permeating substance that binds the whole of the particles of matter together. It is the uniting and binding medium without which, if matter could exist at all, it could exist only as chaotic and isolated fragments: and it is the universal medium of communication between worlds and particles. And yet it is possible for people to deny its existence, because it is unrelated to any of our senses, except sight—and to that only in an indirect and not easily recognised fashion.

To illustrate the thorough way in which we may be unable to detect what is around us unless it has some link or bond which enables it to make appeal, let me make another quotation from Sir J. J. Thomson's address at Winnipeg in 1909. He is leading up to the fact that even single atoms, provided they are fully electrified with the proper atomic charge, can be detected by certain delicate instruments—their field of force bringing them within our ken—whereas a whole crowd of unelectrified ones would escape observation.

"The smallest quantity of unelectrified matter ever detected is probably that of neon, one of the inert gases of the atmosphere. Prof. Strutt has shown that the amount of neon in 1/20 of a cubic centimetre of the air at ordinary pressures can be detected by the spectroscope; Sir William Ramsay estimates that the neon in the air only amounts to one part of neon in 100,000 parts of air, so that the neon in 1/20 of a cubic centimetre of air would only occupy at atmospheric pressure a volume of half a millionth of a cubic centimetre. When stated in this form the quantity seems exceedingly small, but in this small volume there are about ten million million molecules. Now the population of the earth is estimated at about fifteen hundred millions, so that the smallest number of molecules of neon we can identify is about 7000 times the population of the earth. In other words, if we had no better test for the existence of a man than we have for that of an unelectrified molecule we should come to the conclusion that the earth is uninhabited."

The parable is a striking one, for on these lines it might legitimately be contended that we have no right to say positively that even space is uninhabited. All we can safely say is that we have no means of

[5] In the historical case of governmental interference with the calendar, no wonder the populace rebelled. Surely someone might have explained to the authorities that dropping leap year for the greater part of a century would do all that was wanted, and that the horrible inconvenience of upsetting all engagements and shortening a single year by eleven days could be avoided.

[6] Different modes of estimating the change give slightly different results; some involve a compression as well as a distortion—in fact the strain associated with the name of Thomas Young; the details are rather complicated and this is not the place to discuss them. A pure shear, of magnitude specified in the text, is simplest, it is in accord with all the experimental facts—including some careful measurements by Bucherer—and I rather expect it to survive.

detecting the existence of non-planetary immaterial dwellers, and that unless they have some link or bond with the material they must always be physically beyond our ken. We may therefore for practical purposes legitimately treat them as non-existent until such link is discovered, but we should not dogmatise about them. True agnosticism is legitimate, but not the dogmatic and positive and gnostic variety.

But I hold that science is incompetent to make comprehensive denials, even about the æther, and that it goes wrong when it makes the attempt. Science should not deal in negations: it is strong in affirmations, but nothing based on abstraction ought to presume to deny outside its own region. It often happens that things abstracted from and ignored by one branch of science may be taken into consideration by another:—

Thus, chemists ignore the æther.

Mathematicians may ignore experimental difficulties.

Physicists ignore and exclude live things.

Biologists exclude mind and design.

Psychologists may ignore human origin and human destiny.

Folk-lore students and comparative mythologists need not trouble about what modicum of truth there may be in the legends which they are collecting and systematising.

And microscopists may ignore the stars.

Yet none of these ignored things should be denied.

Denial is no more infallible than assertion. There are cheap and easy kinds of scepticism, just as there are cheap and easy kinds of dogmatism; in fact, scepticism can become viciously dogmatic, and science has to be as much on its guard against personal predilection in the negative as in the positive direction. An attitude of universal denial may be very superficial.

"To doubt everything or to believe everything are two equally convenient solutions; both dispense with the necessity of reflection."

All intellectual processes are based on abstraction. For instance, history must ignore a great multitude of facts in order to treat any intelligently: it selects. So does art; and that is why a drawing is clearer than reality. Science makes a diagram of reality, displaying the works, like a skeleton clock. Anatomists dissect out the nervous system, the blood vessels, and the muscles, and depict them separately—there must be discrimination for intellectual grasp—but in life they are all merged and co-operating together; they do not really work separately, though they may be studied separately. A scalpel discriminates: a dagger or a bullet crashes through everything. That is life—or rather death. The laws of nature are a diagrammatic framework, analysed or abstracted out of the full comprehensiveness of reality.

Hence it is that science has no authority in denials. To deny effectively needs much more comprehensive knowledge than to assert. And abstraction is essentially not comprehensive: one cannot have it both ways. Science employs the methods of abstraction, and thereby makes its discoveries.

The reason why some physiologists insist so strenuously on the validity and self-sufficiency of the laws of physics and chemistry, and resist the temptation to appeal to unknown causes—even though the guiding influence and spontaneity of living things are occasionally conspicuous as well as inexplicable—is that they are keen to do their proper work; and their proper work is to pursue the laws of ordinary physical energy into the intricacies of "colloidal electrolytic structures of great chemical complexity" and to study its behaviour there.

What we have clearly to grasp, on their testimony, is that for all the terrestrial manifestations of life the ordinary physical and chemical processes have to serve. There are not new laws for living matter, and old laws for non-living, the laws are the same; or if ever they differ, the burden of proof rests on him who sustains the difference. The conservation of energy, the laws of chemical combination, the laws of electric currents, of radiation, &c., &c.—all the laws of chemistry and physics—may be applied without hesitation in the organic domain. Whether they are sufficient is open to question, but as far as they go they are necessary; and it is the business of the physiologist to seek out and demonstrate the action of those laws in every vital action.

This is clearly recognised by the leaders, and in the definition of physiology by Burdon Sanderson he definitely limited it to the study of "ascertainable characters of a chemical and physical type." In his address to the Subsection of Anatomy and Physiology at York in 1881 he spoke as follows:—

"It would give you a true idea of the nature of the great advance which took place about the middle of this century if I were to define it as the epoch of the death of 'vitalism.' Before that time, even the greatest biologists—*e.g.* J. Müller—recognised that the knowledge biologists possessed both of vital and physical phenomena was insufficient to refer both to a common measure. The method, therefore, was to study the processes of life in relation to each other only. Since that time it has become fundamental in our science not to regard any vital process as understood at all unless it can be brought into relation with physical standards, and the methods of physiology have been based exclusively on this principle. The most efficient cause [conducing to the change] was the progress which had been made in physics and chemistry, and particularly those investigations which led to the establishment of the doctrine of the conservation of energy. . . .

"Investigators who are now working with such earnestness in all parts of the world for the advance of physiology, have before them a definite and well-understood purpose, that purpose being to acquire an exact knowledge of the chemical and physical processes of animal life and of the self-acting machinery by which they are regulated for the general good of the organism. The more singly and straightforwardly we direct our efforts to these ends, the sooner we shall attain to the still higher purpose—the effectual application of our knowledge for the increase of human happiness."

Prof. Gotch, whose recent loss we have to deplore, puts it more strongly:—

"It is essentially unscientific," he says, "to say that any physiological phenomenon is caused by vital force."

I observe that by some critics I have been called a vitalist, and in a sense I am; but I am not a vitalist if vitalism means an appeal to an undefined "vital force" (an objectionable term I have never thought of using) as against the laws of chemistry and physics. Those laws must be supplemented, but need by no means be superseded. The business of science is to trace out their mode of action everywhere, as far and as fully as possible; and it is a true instinct which resents the mediæval practice of freely introducing spiritual and unknown causes into working science. In science an appeal to occult qualities must be illegitimate, and be a barrier to experiment and research generally; as, when anything is called an act of God—and when no more is said. The occurrence is left unexplained. As an ultimate statement such a phrase may be not only true but universal in its application. But there are always proximate explanations which may be looked for and discovered with patience. So, lightning, earthquakes, and other potents are reduced to natural causes. No ultimate explanation is ever attained by science: proximate explanations only. They are what it exists for; and it is the business of scientific men to seek them.

To attribute the rise of sap to vital force would be absurd, it would be giving up the problem and stating nothing at all. The way in which osmosis acts to produce the remarkable and surprising effect is discoverable and has been discovered.

So it is always in science, and its progress began when unknown causes were eliminated and treated as non-existent. Those causes, so far as they exist, must establish their footing by direct investigation and research; carried on in the first instance apart from the long-recognised branches of science, until the time when they too have become sufficiently definite to be entitled to be called scientific. Outlandish territories may in time be incorporated as states, but they must make their claim good and become civilised first.

It is well for people to understand this definite limitation of scope quite clearly, else they wrest the splendid work of biologists to their own confusion—helped it is true by a few of the more robust or less responsible theorisers, among those who should be better informed and more carefully critical in their philosophising utterances.

But, as is well known, there are more than a few biologists who, when taking a broad survey of their subject, clearly perceive and teach that, before all the actions of live things are fully explained, some hitherto excluded causes must be postulated. Ever since the time of J. R. Mayer it has been becoming more and more certain that, as regards performance of work, a living thing obeys the laws of physics, like everything else; but undoubtedly it initiates processes and produces results that without it could not have occurred—from a bird's nest to a honeycomb, from a deal box to a warship. The behaviour of a ship firing shot and shell is explicable in terms of energy, but the discrimination which it exercises between friend and foe is not so explicable. There is plenty of physics and chemistry and mechanics about every vital action, but for a complete understanding of it something beyond physics and chemistry is needed.

And life introduces an incalculable element. The vagaries of a fire or a cyclone could all be predicted by Laplace's calculator, given the initial positions, velocities, and the law of acceleration of the molecules; but no mathematician could calculate the orbit of a common house-fly. A physicist into whose galvanometer a spider had crept would be liable to get phenomena of a kind quite inexplicable, until he discovered the supernatural, *i.e.*, literally superphysical, cause. I will risk the assertion that life introduces something incalculable and purposeful amid the laws of physics; it thus distinctly supplements those laws, though it leaves them otherwise precisely as they were and obeys them all.

We see only its effect, we do not see life itself. Conversion of inorganic into organic is effected always by living organisms. The conversion under those conditions certainly occurs, and the process may be studied. Life appears necessary to the conversion; which clearly takes place under the guidance of life, though in itself it is a physical and chemical process. Many laboratory conversions take place under the guidance of life, and, but for the experimenter, would not have occurred.

Again, putrefaction, and fermentation, and purification of rivers, and disease, are not purely and solely chemical processes. Chemical processes they are, but they are initiated and conducted by living organisms. Just when medicine is becoming biological, and when the hope of making the tropical belt of the earth healthily habitable by energetic races is attracting the attention of people of power, philosophising biologists should not attempt to give their science away to chemistry and physics. Sections D and H and I and K are not really subservient to A and B. Biology is an independent science, and it is served, not dominated, by chemistry and physics.

Scientific men are hostile to superstition, and rightly so, for a great many popular superstitions are both annoying and contemptible; yet occasionally the term may be wrongly applied to practices of which the theory is unknown. To a superficial observer some of the practices of biologists themselves must appear grossly superstitious. To combat malaria Sir Ronald Ross does not indeed erect an altar; no, he oils a pond—making libation to its presiding genii. What can be more ludicrous than the curious and evidently savage ritual, insisted on by United States officers, at that hygienically splendid achievement, the Panama Canal—the ritual of punching a hole in every discarded tin, with the object of keeping off disease! What more absurd, again—in superficial appearance—than the practice of burning or poisoning a soil to make it extra fertile!

Biologists in their proper field are splendid, and their work arouses keen interest and enthusiasm in all whom they guide into their domain. Most of them do their work by intense concentration, by narrowing down their scope, not by taking a wide survey or a comprehensive grasp. Suggestions of broader views and outlying fields of knowledge seem foreign to the intense worker, and he resents them. For his own purpose he wishes to ignore them, and practically he may be quite right. The folly of negation is not his, but belongs to those who misinterpret or misapply his utterances, and take him as a guide in a region where, for the time at least, he is a stranger. Not by such aid is the universe in its broader aspects to be apprehended. If people in general were better acquainted with science they would not make these mistakes. They would realise both the learning and the limitations, make use of the one and allow for the other, and not take the recipe of a practical worker for a formula wherewith to interpret the universe.

What appears to be quite certain is that there can be no terrestrial manifestation of life without matter. Hence naturally they say, or they approve such sayings as, "I discern in matter the promise and potency of all forms of life." Of all terrestrial manifestations of life, certainly. How else could it manifest itself save through matter? "I detect nothing in the organism but the laws of chemistry and physics," it is said. Very well: naturally enough. That is what they are after; they are studying the physical and chemical aspects or manifestations of life. But life itself—life and mind and consciousness—they are not studying, and they exclude them from their purview. Matter is what appeals to our senses here and now; materialism is appropriate to the material world; not as a philosophy but as a working creed, as a proximate and immediate formula for guiding research. Everything beyond that belongs to another region, and must be reached by other methods. To explain the psychical in terms of physics and chemistry is simply impossible; hence there is a tendency to deny its existence, save as an epiphenomenon. But all such philosophising is unjustified, and is really bad metaphysics.

So if ever in their enthusiasm scientific workers go too far and say that the things they exclude from study have no existence in the universe, we must appeal against them to direct experience. We ourselves are alive, we possess life and mind and consciousness, we have first-hand experience of these things, quite apart from laboratory experiments. They belong to the common knowledge of the race. Births, deaths, and marriages are not affairs of the biologist, but of humanity; they went on before a single one of them was understood, before a vestige of science existed. We ourselves are the laboratory in which men of science, psychologists, and others make experiments. They can formulate our processes of digestion, and the material concomitants of willing, of sensation, of thinking; but the hidden guiding entities they do not touch.

So also if any philosopher tells you that you do not exist, or that the external world does not exist, or that you are an automaton without free will, that all your actions are determined by outside causes, and that you are not responsible—or that a body cannot move out of its place, or that Achilles cannot catch a tortoise; then in all those cases appeal must be made to twelve average men, unsophisticated by special studies. There is always a danger of error in interpreting experience, or in drawing inferences from it; but in a matter of bare fact, based on our own first-hand experience, we are able to give a verdict. We may be mistaken as to the nature of what we see. Stars may look to us like bright specks in a dome, but the fact that we see them admits of no doubt. So also consciousness and will are realities of which we are directly aware, just as directly as we are of motion and force, just as clearly as we apprehend the philosophising utterances of an Agnostic. The process of seeing, the plain man does not understand; he does not recognise that it is a method of æthereal telegraphy; he knows nothing of the æther and its ripples, nor of the retina and its rods and cones, nor of nerve and brain processes; but he sees and he hears and he touches, and he wills and he thinks and is conscious. This is not an appeal to the mob as against the philosopher, it is appeal to the experience of untold ages as against the studies of a generation.

How consciousness became associated with matter, how life exerts guidance over chemical and physical forces, how mechanical motions are translated into sensations—all these things are puzzling and demand long study. But the fact that these things are so admits of no doubt; and difficulty of explanation is no argument against them. The blind man restored to sight had no opinion as to how he was healed, nor could he vouch for the moral character of the Healer, but he plainly knew that whereas he was blind now he saw. About that fact he was the best possible judge. So it is also with "this main miracle that thou art thou, With power on thine own act and on the world."

But although life and mind may be excluded from physiology, they are not excluded from science. Of course not. It is not reasonable to say that things necessarily elude investigation merely because we do not knock against them. Yet the mistake is sometimes made. The æther makes no appeal to sense, therefore some are beginning to say that it does not exist. Mind is occasionally put into the same predicament. Life is not detected in the laboratory, save in its physical and chemical manifestations; but we may have to admit that it guides processes nevertheless. It may be called a catalytic agent.

To understand the action of life itself, the simplest plan is not to think of a microscopic organism, or any unfamiliar animal, but to make use of our own experience as living beings. Any positive instance serves to stem a comprehensive denial; and if the reality of mind and guidance and plan is denied because they make no appeal to sense, then think how the world would appear to an observer to whom the existence of men was unknown and undiscoverable, while yet all the laws and activities of nature went on as they do now.

Suppose, then, that *man* made no appeal to the senses of an observer of this planet. Suppose an outside observer could see all the events occurring in the world, save only that he could not see animals or men. He would describe what he saw much as we have to describe the activities initiated by life.

If he looked at the Firth of Forth, for instance, he would see piers arising in the water, beginning to sprout, reaching across in strange manner till they actually join or are joined by pieces attracted up from below to complete the circuit (a solid circuit round the current). He would see a sort of bridge or filament thus constructed, from one shore to the other, and across this bridge insect-like things crawling and returning for no very obvious reason.

Or let him look at the Nile, and recognise the meritorious character of that river in promoting the growth of vegetation in the desert. Then let him see a kind of untoward crystallisation growing across and beginning to dam the beneficent stream. Blocks fly to their places by some kind of polar forces; "we cannot doubt" that it is by helio- or other tropism. There is no need to go outside the laws of mechanics and physics, there is no difficulty about supply of energy—none whatever—materials in tin cans are consumed which amply account for all the energy; and all the laws of physics are obeyed. The absence of any design, too, is manifest; for the effect of the structure is to flood an area up-stream which might have been useful, and to submerge a structure of some beauty; while down stream its effect is likely to be worse, for it would block the course of the river and waste it on the desert, were it not that fortunately some leaks develop and a sufficient supply still goes down—goes down, in fact, more equably than before: so that the ultimate result is beneficial to vegetation, and simulates intention.

If told concerning either of these structures that an engineer, a designer in London, called Benjamin Baker, had anything to do with it, the idea would be preposterous. One conclusive argument is final against such a superstitious hypothesis—he is not there, and a thing plainly cannot act where it is not. But although we, with our greater advantages, perceive that the right solution for such an observer would be the recognition of some unknown agency or agent, it must be admitted that an explanation in terms of a vague entity called vital force would be useless, and might be so worded as to be misleading; whereas a statement in terms of mechanics and physics could be clear and definite and true as far as it went, though it must necessarily be incomplete.

And note that what we observe, in such understood cases, is an *interaction* of mind and matter; not parallelism nor epiphenomenalism nor anything strained or difficult, but a straightforward utilisation of the properties of matter and energy for purposes conceived in the mind, and executed by muscles guided by acts of will.

But, it will be said, this is unfair, for we *know* that there is design in the Forth Bridge or the Nile Dam, we have seen the plans and understand the agencies at work: we know that it was conceived and guided by life and mind, it is unfair to quote this as though it could simulate an automatic process.

Not at all, say the extreme school of biologists whom I am criticising, or ought to say if they were consistent, there is nothing but chemistry and physics at work anywhere; and the mental activity apparently demonstrated by those structures is only an illusion, an epiphenomenon; the laws of chemistry and physics are supreme, and they are sufficient to account for everything!

Well, they account for things up to a point; they account in part for the colour of a sunset, for the majesty of a mountain peak, for the glory of animate existence. But do they account for everything completely? Do they account for our own feeling of joy and exaltation, for our sense of beauty, for the manifest beauty existing throughout nature? Do not these things suggest something higher and nobler and more joyous, something for the sake of which all the struggle for existence goes on?

Surely there must be a deeper meaning involved in natural objects. Orthodox explanations are only partial, though true as far as they go. When we examine each parti-coloured pinnule in a peacock's tail, or hair in a zebra's hide, and realise that the varying shades on each are so placed as to contribute to the general design and pattern, it becomes exceedingly difficult to explain how this organised co-operation of parts, this harmonious distribution of pigment cells, has come about on merely mechanical principles. It would be as easy to explain the sprouting of the cantilevers of the Forth Bridge from its piers, or the flocking of the stones of the Nile Dam by chemiotaxis. Flowers attract insects for fertilisation; and fruit tempts animals to eat it in order to carry seeds. But these explanations cannot be final. We have still to explain the insects. So much beauty cannot be necessary merely to attract their attention. We have further to explain this competitive striving towards life. Why do things struggle to exist? Surely the effort must have some significance, the development some aim. We thus reach the problem of existence itself, and the meaning of evolution.

The mechanism whereby existence entrenches itself is manifest, or at least has been to a large extent discovered. Natural selection is a *vera causa*, so far as it goes; but if so much beauty is necessary for insects, what about the beauty of a landscape or of clouds? What utilitarian object do those subserve? Beauty in general is not taken into account by science. Very well, that may be all right, but it exists nevertheless. It is not my function to discuss it. No; but it is my function to remind you and myself that that our studies do not exhaust the universe, and that if we dogmatise in a negative direction, and say that we can reduce everything to physics and chemistry, we gibbet ourselves as ludicrously narrow pedants, and are falling far short of the richness and fullness of our human birthright. How far preferable is the reverent attitude of the Eastern poet:—

"The world with eyes bent upon thy feet stands in awe with all its silent stars."

Superficially and physically we are very limited. Our sense organs are adapted to the observation of matter; and nothing else directly appeals to us. Our nerve-muscle-system is adapted to the production of motion in matter, in desired ways; and nothing else in the material world can we accomplish. Our brain and nerve systems connect us with the rest of the physical world. Our senses give us information about the movements and arrangements of matter. Our muscles enable us to produce changes in those distributions. That is our equipment for human life; and human history is a record of what we have done with these parsimonious privileges.

Our brain, which by some means yet to be discovered connects us with the rest of the material world, has been thought partially to disconnect us from the mental and spiritual realm, to which we really belong, but from which for a time and for practical purposes we are isolated. Our common or social association with matter gives us certain opportunities and facilities, combined with obstacles and difficulties which are themselves opportunities for struggle and effort.

Through matter we become aware of each other, and can communicate with those of our fellows who have ideas sufficiently like our own for them to be stimulated into activity by a merely physical process set in action by ourselves. By a time succession of vibratory movements (as in speech and music), or by a static distribution of materials (as in writing, painting, and sculpture), we can carry on intelligent intercourse with our fellows; and we get so used to these ingenious and roundabout methods, that we are apt to think of them and their like as not only the natural but as the only possible modes of communication, and that anything more direct would disarrange the whole fabric of science.

It is clearly true that our bodies constitute the normal means of manifesting ourselves to each other while on the planet; and that if the physiological mechanism whereby we accomplish material acts is injured, the conveyance of our meaning and the display of our personality inevitably and correspondingly suffer.

So conspicuously is this the case that it has been possible to suppose that the communicating mechanism, formed and worked by us, is the whole of our existence: and that we are essentially nothing but the machinery by which we are known. We find the machinery utilising nothing but well-known forms of energy, and subject to all the laws of chemistry and physics—it would be strange if it were not so—and from that fact we try to draw valid deductions as to our nature, and as to the impossibility of our existing apart from and independent of these temporary modes of material activity and manifestation. We so uniformly employ them, in our present circumstances, that we should be on our guard against deception due to this very uniformity. Material bodies are all that we have any control over, are all that we are experimentally aware of; anything that we can do with these is open to us; any conclusions we can draw about them may be legitimate and true. But to step outside their province and to deny the existence of any other region because we have no sense organ for its appreciation, or because (like the æther) it is too uniformly omnipresent for our ken, is to wrest our advantages and privileges from their proper use and apply them to our own misdirection.

But if we have learnt from science that evolution is real, we have learnt a great deal. I must not venture to philosophise, but certainly from the point of view of science evolution is a great reality. Surely evolution is not an illusion; surely the universe progresses in time. Time and space and matter are abstractions, but are none the less real: they are data given by experience; and time is the keystone of evolution. "Thy centuries follow each other, perfecting a small wild flower."

We abstract from living, moving reality a certain static aspect, and we call it matter; we abstract the element of progressiveness, and we call it time. When these two abstractions combine, co-operate, interact, we get reality again. It is like Poynting's theorem.

The only way to refute or confuse the theory of evolution is to introduce the subjectivity of time. That theory involves the reality of time, and it is in this sense that Prof. Bergson uses the great phrase "creative evolution."

I see the whole of material existence as a steady passage from past to future, only the single instant which we call the present being actual. The past is not non-existent, however, it is stored in our memories, there is a record of it in matter, and the present is based upon it; the future is the outcome of the present, and is the product of evolution.

Existence is like the output from a loom. The pattern, the design for the weaving, is in some sort "there" already; but whereas our looms are mere machines, once the guiding cards have been fed into them, the loom of time is complicated by a multitude of free agents who can modify the web, making the product more beautiful or more ugly according as they are in harmony or disharmony with the general scheme. I venture to maintain that manifest imperfections are thus accounted for, and that *freedom* could be given on no other terms, nor at any less cost.

The ability thus to work for weal or woe is no illusion, it is a reality, a responsible power which conscious agents possess; wherefore the resulting fabric is not something preordained and inexorable, though by wide knowledge of character it may be inferred. Nothing is inexorable except the uniform progress of time; the cloth must be woven, but the pattern is not wholly fixed and mechanically calculable.

Where inorganic matter alone is concerned, there everything is determined. Wherever full consciousness has entered, new powers arise, and the faculties and desires of the conscious parts of the scheme have an effect upon the whole. It is not guided from outside, but from within; and the guiding power is immanent at every instant. Of this guiding power we are a small but not wholly insignificant portion.

That evolutionary progress is real is a doctrine of profound significance, and our efforts at social betterment are justified because we are a part of the scheme, a part that has become conscious, a part that realises, however dimly, what it is doing and what it is aiming at. Planning and aiming are therefore not absent from the whole, for we are a part of the whole, and are conscious of them in ourselves.

Either we are immortal beings or we are not. We may not know our destiny, but we must have a destiny of some sort. Those who make denials are just as likely to be wrong as those who make assertions: in fact, denials are assertions thrown into negative form. Scientific men are looked up to as authorities, and should be careful not to mislead. Science may not be able to reveal human destiny, but it certainly should not obscure it. Things are as they are, whether we find them out or not; and if we make rash and false statements, posterity will detect us—if posterity ever troubles its head about us. I am one of those who think that the methods of science are not so limited in their scope as has been thought: that they can be applied much more widely, and that the psychic region can be studied and brought under law too. Allow us anyhow to make the attempt. Give us a fair field. Let those who prefer the materialistic hypothesis by all means develop their thesis as far as they can; but let us try what we can do in the psychical region, and see which wins. Our methods are really the same as theirs—the subject-matter differs. Neither should abuse the other for making the attempt.

Whether such things as intuition and revelation ever occur is an open question. There are some who have reason to say that they do. They are at any rate not to be denied off-hand. In fact, it is always extremely difficult to deny *anything* of a general character, since evidence in its favour may be only hidden and not forthcoming, especially not forthcoming at any particular age of the world's history, or at any particular stage of individual mental development. Mysticism must have its place, though its relation to science has so far not been found. They have appeared disparate and disconnected, but there need be no hostility between them. Every kind of reality must be ascertained and dealt with by proper methods. If the voices of Socrates and of Joan of Arc represent real psychical experiences, they must belong to the intelligible universe.

Although I am speaking *ex cathedra*, as one of the representatives of orthodox science, I will not shrink from a personal note summarising the result on my own mind of thirty years' experience of psychical research, begun without predilection—indeed, with the usual hostile prejudice. This is not the place to enter into details or to discuss facts scorned by orthodox science, but I cannot help remembering that an utterance from this chair is no ephemeral production, for it remains to be criticised by generations yet unborn, whose knowledge must inevitably be fuller and wider than our own. Your President, therefore, should not be completely bound by the shackles of present-day orthodoxy, nor limited to beliefs fashionable at the time. In justice to myself and my co-workers, I must risk annoying my present hearers, not only by leaving on record our conviction that occurrences now regarded as occult can be examined and reduced to order by the methods of science carefully and persistently applied, but by going further and saying, with the utmost brevity, that already the facts so examined have convinced me that memory and affection are not limited to that association with matter by which alone they can manifest themselves here and now, and that personality persists beyond bodily death. The evidence, to my mind, goes to prove that discarnate intelligence, under certain conditions, may interact with us on the material side, thus indirectly coming within our scientific ken; and that gradually we may hope to attain some understanding of the nature of a larger, perhaps ætherial, existence, and of the conditions regulating intercourse across the chasm. A body of responsible investigators has even now landed on the treacherous but promising shores of a new continent.

Yes, and there is more to say than that. The methods of science are not the only way, though they are our way, of being piloted to truth. "*Uno itinere non potest perveniri ad tam grande secretum.*"

Many scientific men still feel in pugnacious mood towards theology, because of the exaggerated dogmatism which our predecessors encountered and overcame in the past. They had to struggle for freedom to find truth in their own way; but the struggle was a miserable necessity, and has left some evil effects. And one of them is this lack of sympathy, this occasional hostility, to other more spiritual forms of truth. We cannot really and seriously suppose that truth began to arrive on this planet a few centuries ago. The pre-scientific insight of genius—of poets and prophets and saints—was of supreme value, and the access of those inspired seers to the heart of the universe was profound. But the camp followers, the scribes and pharisees, by whatever name they may be called, had no such insight, only a vicious or a foolish obstinacy; and the prophets of a new era were stoned.

Now at last we of the new era have been victorious, and the stones are in our hands; but for us to imitate the old ecclesiastical attitude would be folly. Let us not fall into the old mistake of thinking that ours is the only way of exploring the multifarious depths of the universe, and that all others are worthless and mistaken. The universe is a larger thing than we have any conception of, and no one method of search will exhaust its treasures.

Men and brethren, we are trustees of the truth of the physical universe as scientifically explored: let us be faithful to our trust.

Genuine religion has its roots deep down in the heart of humanity and in the reality of things. It is not surprising that by our methods we fail to grasp it: the actions of the Deity make no appeal to any special sense, only a universal appeal; and our methods are, as we know, incompetent to detect complete uniformity. There is a principle of relativity here, and unless we encounter flaw or jar or change, nothing in us responds; we are deaf and blind, therefore, to the Immanent Grandeur unless we have insight enough to recognise in the woven fabric of existence, flowing steadily from the loom in an infinite progress towards perfection, the ever-growing garment of a transcendant God.

SUMMARY OF THE ARGUMENT.

A marked feature of the present scientific era is the discovery of, and interest in, various kinds of atomism; so that continuity seems in danger of being lost sight of.

Another tendency is toward comprehensive negative generalisations from a limited point of view.

Another is to take refuge in rather vague forms of statement, and to shrink from closer examination of the puzzling and the obscure.

Another is to deny the existence of anything which makes no appeal to organs of sense, and no ready response to laboratory experiment.

Against these tendencies the author contends. He urges a belief in ultimate continuity as essential to science; he regards scientific concentration as an inadequate basis for philosophic generalisation; he believes that obscure phenomena may be expressed simply if properly faced; and he points out that the non-appearance of anything perfectly uniform and omnipresent is only what should be expected, and is no argument against its real substantial existence.

NOTES.

IN view of the meeting of the British Association, a "Handbook for Birmingham and the Neighbourhood" has been issued (under the editorshio of Dr. G. A. Auden) at the price of 3*s*. 6*d*. net by Messrs. Cornish Bros., Ltd., Birmingham. The volume is of an encyclopædic character, and should be of great service not only to members of the British Association, but to all who are interested in things pertaining to Birmingham. The work is divided into five main divisions—historical, municipal, educational, industrial, and scientific. In the latter, which of course appeals more especially to our readers, botany is dealt with by Prof. West and Messrs. Grove, Humphreys, Cleminshaw, and Duncan; Midland reafforesting by P. E. Martineau; the ornithology of the district by R. W. Chase; insects by H. W. Ellis; mammalia, amphibia, reptilia, and pisces by H. E. Forrest; microscopic aquatic fauna by H. W. H. Darlaston; meteorology by A. Cresswell; and the geology and physiography of the Birmingham country by Prof C. Lapworth, F.R.S. The last-named contribution is supplemented by very clear geological and topographical maps executed by Messrs. John Bartholomew and Co., of Edinburgh. Besides these maps, there are a number of illustrations in the text. Altogether the volume is an admirable production, and worthy of the occasion for which it has been prepared.

Apropos of the British Association meeting, a recent number of *The Westminster Gazette* contains an article on the Lunar Society, the members of which used to meet monthly in Birmingham in the eighteenth century, as nearly as possible at the time of full moon that they might have the benefit of its light in returning home—hence the name of the society. Each member was permitted to bring a friend, and some very distinguished men from time to time enjoyed the society's hospitality. Thus we find that among such guests were Sir Joseph Banks, Sir William Herschel, John Smeaton, of lighthouse fame, Josiah Wedgwood, Prof. Hugh Blair, Afzelius, the Swedish botanist, Daniel Solander, the naturalist, and Andre de Luc, the geologist. Among the members of the society or club were James Watt, Joseph Priestley, and Erasmus Darwin. The Priestley riots dealt a blow to the little society from which it never recovered, and it is therefore now no more than a memory.

PROF. MILNE bequeathed to the British Association his books, albums, and scientific instruments relating to seismology, and, subject to his wife's interest, the sum of 1000*l*. to the chairman of the seismology committee of the British Association for the furtherance of the study of terrestrial physics and its attendant subjects.

A FURTHER grant of 5000*l*., making 10,000*l*. in all, has been made by the Federal Government of the Commonwealth of Australia towards completing the work of the Mawson Antarctic Expedition and bringing the explorers back.

THE sum of 90,000 francs has been bequeathed to the Pasteur Institute at Paris for the founding of a prize for the best original work in the treatment of meningitis.

WE record, with regret, the death on Saturday last of Dr. Hugh Marshall, F.R.S., professor of chemistry in University College, Dundee.

THE death occurred on September 2, at Abo, Finland, at the age of sixty-three years, of Dr. O. M. Reuter, emeritus professor of zoology in the University of Helsingfors.

A BRONZE statue of the late Dr. Ludwig Mond, erected by Messrs. Brunner, Mond and Co., Ltd., on the lawn opposite Winnington Hall, near Northwich, Dr. Mond's residence, is to be unveiled on Saturday next by Sir John Brunner.

A MEMORIAL of the Russian explorer, Baron E. von Toll, in the form of a bronze portrait tablet, is to be set up on Kotelnyi Island, in the New Siberia group, by the leader of the German Taimyrland Expedition.

PAPERS dealing with various problems of heating and lighting are to be read by Prof. Bone, F.R.S., Prof. Vivian B. Lewes, Mr. L. Gaster, and Mr. T. Thorne Baker at a conference which is to take place on October 29 in connection with the National Gas Congress and Exhibition.

THE plumage prohibition clause in the United States Tariff Bill having been sanctioned by the Senate the importation into the United States of the plumage of wild birds, either raw or manufactured, for purposes other than scientific or educational, is prohibited.

THE first installation of wireless telephony in a coal mine in Great Britain has just been fitted up at Dinnington Main Colliery, South Yorkshire, with, it is said, satisfactory results. The system is the invention of Mr. J. H. Reinecke, of Bochum, Westphalia, and is in use in German collieries. According to *The Times* each instrument is connected by two wires with a piece of metal buried in the ground. The wires can also be attached to ordinary tramway rails, water-pipes, &c. At Dinnington instruments have been placed at two points—one in the transformer house near the pit bottom and the other 1000 yards "in-bye," and conversation has been carried on between these points just as through an ordinary telephone with the use of only about 20 yards of wire. The system also admits of the use of portable instruments weighing about 20 lb. each by means of which it is possible to communicate with the fixed stations from any part of the mine. All that is necessary is for the operator to attach the two wires of the instrument to any metallic substance at hand. Thus in the event of a disaster in a pit miners entombed by falls would be able to open up communication with other parts of the colliery. In ordinary working the portable instruments should be very useful in the case of a breakdown of the signalling apparatus, and coal turning could be carried on while the repairs were being done. The portable instrument can also be used in the cage while ascending or descending the shaft.

THE Italian archæological mission to Crete, under the leadership of Prof. Halbherr, announces the discovery at Cortina of a temple dedicated to Egyptian deities, bearing a dedication by Flavia Philyra, the foundress. In the inner cella were found images of Jupiter, Serapis, Isis, and Mercury, with fragments of a colossal statue, supposed to be that of the foundress. A little flight of steps leads down to a subterranean chamber in which ceremonies of purification were performed.

THE excavation of the numerous prehistoric sites in the island of Malta is being actively prosecuted under the direction of Prof. T. Zammit. The most important discovery is that of a series of well tombs of the Punic type at the Kallilia plateau, north-west of Rabat. A large number of skeletons, with pottery, lamps, spindle-whorls, and a circular bronze mirror, has been unearthed. A partial exploration of the Ghar Dalam cave, conducted by Prof. Tagliaferro and Mr. C. Rizzo, produced bones of a hippopotamus and a deer, above which lay a quantity of prehistoric sherds. The museum, by the bequest of the late Mr. Parnis, has received a large collection of books about Malta and numerous antique objects. The *Malta Herald*, in recording the progress of excavation, very reasonably urges that means should be taken to protect the sites partially examined from spoliation by the villagers.

LESS than 300 miles to the north of Rio de Janeiro, on the coast range of Minas Geraes, live the Uti-krag, a tribe of Botocudos still retaining some of their old customs, but rapidly succumbing to the fostering care of the recently established Board of Protection of the Native Indians. Mr. W. Knocke paid them a very short visit in the month of October, 1912, and he describes his observations in a pamphlet entitled "Algunas Indicaciones sobre los Uti-krag del Rio Doce," issued separately from the *Revista de Historia y Geografia* (vol. v., 1913). The name of Botocudos, given them by the Portuguese, refers to the plugs with which the men distend their ear lobes, the women also the lower lip; this is now becoming unfashionable. When in their wilds the women are stark naked. They are the ugly and less intelligent sex, with a considerably darker colour than the decidedly intelligent men. Their household goods seem to be restricted to bows and arrows, plaited bags, and bamboo water-vessels; consequently they cannot cook, but only roast their food. They are clay-eaters. The nasal flute is disappearing. They are able to count up to five, have three kinds of dances, and bury their dead. There is the following curious parallelism between these Uti-krag, which in their idiom means Tortoise-Sierra, and the Mimba of New Guinea (*cf.* Pilhofer, *Petermann's Mittheil.*, September, 1912):—They construct stockades by putting numbers of sharpened sticks, 4 to 5 in. in length, into the ground, covered with leaves. As the enemy, when treading on these spikes, is sure to stumble, he falls upon a second line of larger sharpened sticks, also concealed. The author thinks that this little tribe is not so much a sample of the vigorous primitive savage as rather ethically impoverished through life in the forest. There are eight photographs of the people, their arms, and the stockade spikes.

THE excellence of the work being done by French physical anthropologists is exemplified by the elaborate descriptive memoir by Prof. M. R. Anthony on the fossil skull of La Quina, contributed to *Bulletins et Mémoires de la Société d'Anthropologie* (No. 2, for 1913). The writer identifies it with the Neanderthal group, including the Spy, La Chapelle, and Gibraltar skulls. This comprehensive, well-illustrated memoir is an important contribution to our knowledge of palæolithic man.

THE seventh annual report on the results of the chemical and bacteriological examination of London waters for the twelve months ending March 31, 1913, by Dr. Houston, has been issued by the Metropolitan Water Board. After a summary of the condition of the raw water and the effects of storage and filtration, Dr. Houston's final conclusion is that the "quality policy" of the Metropolitan Water Board should be directed towards securing an "epidemiologically sterile" water (*i.e.*, a water containing none of the microbes associated with water-borne disease) *antecedent* to filtration, by means of storage (sedimentation, devitalisation, and equalisation), aided, if need be, by the occasional employment of supplementary processes of water purification.

THE final report of the Luangwa Sleeping Sickness Commission, by Dr. Kinghorn, Dr. Yorke, and Mr. Lloyd, published in a recent number of the Annals of Tropical Medicine and Parasitology (vol. vii., No. 2) with many illustrations, is a very important contribution to the study of trypanosomiasis in man and animals. Especially valuable are the observations on the human trypanosome, *T. rhodesiense*, its wide distribution in south Central Africa, its occurrence in wild game and domestic stock, and its transmission by *Glossina morsitans*. The authors affirm emphatically that the fly does not become infective until the trypanosome has invaded its salivary glands, an event which is the second and final act of a developmental cycle that begins in the gut of the fly. It was found that the first portion of this cycle could proceed at lower temperatures (60°–70° F.), but that for its completion higher temperatures (75°–85° F.) are essential. The parasites can, however, persist in the fly at an incomplete stage of their development for at least sixty days under unfavourable climatic conditions. Several species of trypanosomes, some old, some new, are described from wild game or domestic stock; remarkable among the new species is a large form of the ingens-type, to which the name *T. tragelaphi* is given, found in the blood of the sitatunga, *Limnotragus spekei*.

THE problems connected with tsetse-flies and the parasites of man and animals which they unwittingly transmit are perhaps the most important questions with which European administrators of African territories have to deal at the present time, and these troublesome insects continue to receive an amount of attention which their purely scientific interest would never have aroused. In the Annals of Tropical Medicine and Parasitology (vol. vii., Part 2), Prof. Newstead describes a new species of tsetse-fly from the Congo Free State under the name *Glossina severini*; and in the same number Mr. Llewellyn Lloyd publishes records and photographs of the breeding-places of *G. morsitans* at Ngoa, on the Congo-Zambesi watershed. The pupæ of *G. morsitans* were always found either in association with trees or in holes in the ground; in the former case the trees were always abnormal or injured. The pupæ were never found at the base of normal trees or under bushes, and they are always deposited in such positions that they are not likely to be scratched up by game-birds. In the Bulletin of Entomological Research (vol. iv., Part 1), Dr. Scott Macfie discusses, with the aid of many photographs, the distribution of tsetse-flies in the Ilorin province of northern Nigeria, and describes a new variety of *G. palpalis*, with an excellent coloured illustration. In the same journal Dr. J. O. Shircore describes two new varieties of *G. morsitans* from Nyasaland.

THE proceedings of the Orchid Conference held by the Royal Horticultural Society in November last are reported at length in the Society's *Journal* (vol. xxxviii., Part 3). They include four papers read at the Conference, in the first of which Prof. F. Keeble discussed the physiology of fertilisation, with special reference to recent investigations by Lutz, Fitting, and others, and pointed out that pollination may bring about three types of events: (1) fertilisation, (2) changes due to contact of pollen with the stigmatic surface, and (3) results which may be described as intoxications or responses to chemical stimulation. In a paper on the application of genetics to orchid breeding, Major C. C. Hurst recapitulated the first principles of genetics, and pointed out that as regards any one heritable character represented by a factor, there are three distinct kinds of individual plants—homozygous or pure, heterozygous or impure, and zerozygous or wanting. He also dealt with the identification of individual "stud" plants, colour and albinism, self-sterility in orchids, &c.

IT requires an altogether special equipment, not only of exact zoological and historical knowledge but also of sympathetic insight into the conditions which prevailed in the past, to compose such a delightful lecture as that which Prof. F. J. Cole, of Reading, has published in the Transactions of the Liverpool Biological Society (February 14, 1913). In his crisp and epigrammatic treatment of a series of well-chosen incidents he has admirably brought before us "the early days of comparative anatomy," and the feeling of most readers, and especially those who from their personal experience realise how difficult such knowledge is to acquire, will be to emulate Oliver Twist's example and ask for more. It is quite impossible to summarise a report so crowded with curious information, witty comment, and historical insight, illuminating the whole development of the science of comparative anatomy. From the knowledge acquired as a collector of old "anatomies," Dr. Cole has been able to explain the loose methods of publication in the seventeenth and eighteenth centuries, which opened the way for those glaring instances of unscrupulous plagiarism that have ever been a source of amazement to us who live in such vastly different circumstances. But no part of the discourse excels in piquancy and common sense the opening "apology" for the study of the history of biology.

A RECENT number of the *Centralblatt für Bakteriologie, Parasitenkunde*, &c. (Zweite Abt., Band 38) contains a detailed account by O. Schneider-Orelli of investigations on the life-history and habits of *Xyleborus dispar*, one of the bark-beetles (Scolytidæ). This species, notorious for the injuries it inflicts on fruit-trees, is remarkable for its symbiosis with a fungus, *Monilia candida*, Hartig. The female beetles, fertilised in the autumn, hibernate in their burrows through the winter and swarm out in the following April and May. Each female then becomes the foundress of a new colony; she bores into a tree and makes a system of burrows, the walls of which become lined with a growth of the fungus, forming a dense white mass, the so-called "ambrosia." The mother-beetle lays her eggs in the burrows and the larvæ feed on the ambrosia-fungus, not on the wood of the tree. Living cells or spores of the fungus are not to be found in the digestive tract of the larva, pupa, or newly hatched adult beetle, but the female beetles appear to take up the fungus from the walls of the burrow in which they have been bred, and the stomachs of the mother-beetles always contain a store of the fungus, capable of germinating. The culture is started in the new burrows by regurgitation of the fungus from the stomach, and is continued by the beetle plucking off clumps of the young culture and planting them further along in the burrow. If disturbed in her agricultural operations, the mother-beetle hastily swallows as much as she can of the fungus.

In a paper on the psychology of insects, read before the General Malarial Committee at Madras in November, 1912, Prof. Howlett, after giving an account of experiments carried out by him on the response of insects to stimuli, comes to the conclusion that insects are to be regarded "not as intelligent beings consciously shaping a path through life, but as being in a sort of active hypnotic trance." It is claimed that this view of insect-psychology opens up great possibilities in the study of insect carriers of disease, since "it is no intelligent foe we have to fight, but a mere battalion of somnambulists." If we discover the stimuli or particular conditions which determine the actions of an insect, we can apply them to its undoing. It was found, for example, that the females of the fruit-fly, a serious pest in some parts of India, emitted an odour resembling ordinary citronella, and that the males could be caught in very large numbers by baiting traps with citronella, since they came to the traps and remained there apparently under a blind impulse to follow the scent of the female. In this way they had succeeded in checking largely the incidence of the fruit-fly pest.

In reference to a recent paragraph in our notes columns on a large dinosaurian limb-bone from Bushman's River, S. Africa, we have received a letter from Dr. R. Broom pointing out that Owen was incorrect in stating that Anthodon came from that locality, and that (as mentioned in *Brit. Mus. Cat. Foss. Reptilia*) its real place of origin was Stylkrantz. It is added that Anthodon is not a dinosaur, but a pariasaurian, and is thus rightly classified in the work just quoted. Dr. Broom appears to forget that in 1895 (*Rec. Albany Mus.*, vol. i., p. 277) he himself stated in reference to Anthodon that there "seems a strong probability that the three original specimens were got by Bain at Bushman's River." Later on he observed that "by Owen Anthodon was believed to be a dinosaur; by Lydekker and others it has been believed to be allied to Pareiasaurus. . . . The teeth are unlike those of Pareiasaurus, and strikingly like those of dinosaurs, and it seems possible that Owen may ultimately prove to be right." Basing our remarks on these statements, our one error was the assertion that Anthodon is *known* to be a dinosaur. As the Stylkrantz beds are Permian, and those of Bushman's River Cretaceous, there can, of course, be no community between their faunas.

The September number of *The Selborne Magazine* contains a list of lectures delivered before the Selborne Society during the past few years, and the names of the lecturers. Any of these discourses, which cover a great range of subjects, and are profusely illustrated with lantern-slides, the respective lecturers are prepared to repeat, either singly or in series, to local natural history societies or schools in return for their expenses, or moderate fees.

To the August number of *The Irish Naturalist* Dr. R. F. Scharff contributes a note on the Belmullet whaling station, based on a paper by Mr. Burfield in the British Association report for 1912. The number of whales taken by the Blacksod Whaling Company in 1911 was sixty-three, against fifty-five the previous year. The catch of the other company is not given.

An interesting article by Mr. C. H. Eshleman on the "Climatic Effect of the Great Lakes as Typified at Grand Haven, Mich.," on the east of the lake, is published in the meteorological chart for September issued by the U.S. Weather Bureau. Few stations are more favourably placed for this purpose; it has a broad expanse of eighty-five miles of water to the westward, and the shore is comparatively regular and almost straight to the north and south. Its temperature is compared with that of Milwaukee on the west shore, and with several inland stations lying to the westward in the same latitude. The tables show, *inter alia*, that the annual means are practically the same; the monthly maxima along the lake are strikingly modified in spring and summer, but only slightly in the other seasons; the minima are greatly modified in autumn and winter. The lake acts as a barrier against the extreme cold from the far north-west; the temperature at Grand Haven is often 20° higher than at Milwaukee, but with easterly winds it is almost as cold at Grand Haven as away from the lake. All the other climatic features are modified, but the effect on yearly or monthly precipitation is not striking. We notice with regret that the publication of these valuable meteorological charts, including those of the great oceans, has now ceased.

The after-shocks of the Messina earthquake of December 28, 1908, have been referred to in several of our Notes. On the last occasion (vol. xci., p. 93) a summary was given of observations made at Messina during the year 1909. From these it appeared that the distribution in time of the after-shocks did not follow Omori's law, $y=h/(k+x)$, where h and k are constants and y the number of after-shocks during a given interval at time x from the earthquake. These observations, however, referred to all the shocks felt at Messina, and not only to the true after-shocks of the great earthquake. The latter are distinguished in the valuable notices of earthquakes observed in Italy during 1909, of which we have received the last three numbers for the year. From these it is seen that the decline in frequency of the true after-shocks, though exhibiting the usual fluctuations, does not depart widely from Omori's well-known law.

Part 14 of the *Verhandlungen* of the German Physical Society contains further details of the method used and the results obtained by Drs. A. Eucken and F. Schwers, of the University of Berlin, in their measurements of specific heats of substances at very low temperatures. A cylindrical block of the material to be investigated had a constantan heating wire of 2 mm. diameter and 200 ohms resistance wound round it, electrical insulation and adequate thermal contact being secured by varnish. The temperature attained was determined from the resistance of a lead wire wound round the cylinder in the same way. The electrical heating was carried out in a vacuum vessel at temperatures between 16° and 92° on the absolute scale. Over this range the specific heats of fluorspar and iron pyrites crystals vary as the third power of the absolute temperature in agreement with the theory put forward by Debye in the first instance for monatomic substances.

"THE Coal Resources of the World," to which allusion was made in NATURE of September 4, is being brought out in this country by the American Book Supply Co., Ltd., 149 Strand.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A telegram from the Centralstelle at Kiel, dated September 3, announced the discovery of a comet of magnitude 10·0 by Dr. Metcalf, of Winchester, Massachusetts, on September 1, at 8h. 42·0m. M.T. Winchester. Its position was given as RA 6h. 50m., and declination 57° 0′ N., and was stated to have a slow motion to the north. It was suggested that it possibly might be Westphal's comet. A second telegram, dated September 4, stated that Prof. Antoniazzi had seen the same object on September 3 at 15h. 39·4m. M.T. Padua. The position he gave was RA 6h. 48m. 12s., and declination 57° 25′ 34″ N., the daily motion in RA being −1m. 16s., and in declination +34′. According to a writer in *The Times* (September 6), Prof. Antoniazzi's observation indicates that the comet cannot be that of Westphal, as the daily motion is diminishing instead of increasing.

The new comet is in the constellation of the Lynx, and therefore to be observed any time during the night, but best visible after midnight.

The following elements and ephemeris of comet *b* (Metcalf) have been communicated from Kiel, based on the observations of September 2, 3, and 4:—

$$T = 1913 \text{ July } 20.1129 \text{ Berlin.}$$

$$\left.\begin{aligned} \omega &= 51^\circ\ 31{\cdot}47' \\ \Omega &= 136^\circ\ 9{\cdot}99' \\ i &= 142^\circ\ 49{\cdot}23' \end{aligned}\right\} 1913{\cdot}0.$$

$$\log q = 0{\cdot}20954$$

12h. M.T. Berlin.

		R.A. (h. m. s)		Dec.
Sept. 11	...	6 32 54	...	+62 21·6
13	...	27 1	...	63 44·7
15	...	6 19 53		65 10 5

The magnitude is given as 10·5 on September 5 and 10·3 on September 15.

ANOTHER COMET.—Another telegram from Kiel, dated September 7, states that Dr. K. Graff discovered on September 6, at 15h. 9·1m. M.T. Bergedorf, a comet of the 11th magnitude. Its position is given as R.A. 23h. 48m. 1·8s., and declination 0° 27′ 44″ S. It is thus situated in the constellation of Pisces, and should be best seen about midnight.

THE PROTECTION OF SILVERED MIRRORS FROM TARNISHING.—Everyone who uses mirrors for astronomical purposes would welcome a satisfactory method of coating them with some material for preventing tarnishing. M. Perot some years ago published an account of a process he employed successfully for treating mirrors at the Meudon Observatory. It consisted of a thin coating of collodion being applied to the surface of the mirror, the film being obtained by pouring over the mirror a solution of collodion in amyl acetate. The mirrors used at the Helwan Observatory are subject to becoming spotted a few weeks after silvering, and attempts have been made to protect them. Mr. S. H. Trimen, of the Survey Department Laboratories, made the various trials (Khedivial Observatory, Helwan, Bulletin No. 10), but after repeated attempts with solutions of varying percentages he had at length to abandon the process. Blurred images of the stars and curious flares on the photographs of the bright stars were always the result of the application of the film. It is suggested that the problem may possibly be solved by using a solution possessing a lower viscosity, and it is to be hoped that such an attempt will be made.

RESEARCHES ON THE SUN.—The last two numbers of the *Astrophysical Journal* (June and July) have contained several important researches relating to solar physics. Prof. George E. Hale, in the July number, publishes his most valuable paper on the "Preliminary Results of an Attempt to Detect the General Magnetic Field of the Sun," a summary of which, based on an advanced proof, having been given in a previous number of this journal (June 17, p. 505). In connection with this research, Mr. Frederick H. Seares gives in the same number a paper entitled, "The Displacement-curve of the Sun's General Magnetic Field." The spectrum lines observed with the 75-ft. spectrographs and the polarising apparatus of the 150-ft. tower telescope showed displacements that apparently could not be attributed to any other cause than a general magnetic field of the sun, and the object of his research was to provide a more rigorous control of the results and their interpretation. Thus in the paper he compares the observed displacements with the theoretical displacement-curve derived on the assumption that the sun is a magnetised sphere, and further he provides formulæ for determining the position of the magnetic axis relative to the axis of rotation.

In the June number Mr. Charles E. St. John deals with the remarkable discovery by Mr. Evershed of the displacement of the Fraunhofer lines in the penumbræ of sunspots. The paper is entitled, "The Distribution of Velocities in the Solar Vortex," and the observations recorded in this research are in entire accord with Mr. Evershed's hypothesis that the displacements considered are due to a movement of the solar vapours tangential to the solar surface and radial to the axis of the spot vortex. Previous reference has already been made of Prof. Slocum's second paper on the circulation in the solar atmosphere as indicated by prominences.

THE INSTITUTE OF METALS.

THE autumn meeting of the Institute of Metals took place at Ghent on August 28 and 29 last. This was the first occasion on which this institute has held a meeting abroad, and the gathering may be described as a complete success. The attendance of members (about seventy-five) was particularly satisfactory on account of the representative character of those present, the foreign members of the institute, including members from Russia, Germany, Belgium, and America, being particularly well represented. The mornings of August 28 and 29 were devoted to the discussion of a long and interesting list of papers, while the afternoons were utilised for visits to works, the inspection of the exhibition, and the antiquities of the city. The social functions included a reception by the Burgomestre of Ghent in the ancient and beautiful Hotel de Ville.

The foremost place in the work of the meeting was taken by the reading and discussion of the second report to the Corrosion Committee, presented by Dr. G. Bengough and R. M. Jones. This report deals with the examination of a considerable number of examples of corroded tubes from service, of the investigation of the mechanism of corrosion in sea-water, both at the ordinary temperature and at higher temperatures by means of small laboratory experiments, and the systematic study of corrosion in condenser tubes of various composition under conditions as nearly like those of practical service as possible in an experimental condenser plant set up by the committee at Liverpool University. The results as stated in the report are remarkable, and diverge widely from the views generally accepted hitherto. The examination of material from service did not lead to any conclusive results, but the data furnished by the experimental plant—so far as they yet go—confirm the results of the small laboratory experiments. The report deals entirely with the process of corrosion by dezincification, which the authors have found to be the most common form of corrosion, although it appeared in the discussion that they admitted that pitting does occur in the absence of dezincification. They find, however, that none of the alloys tested by them undergo selective corrosion or dezincification when exposed to sea-water at the ordinary temperature, but they are all subject to it at higher temperatures, the process becoming vigorous towards 40° C. The action of dezincification is connected by the authors with the formation of a basic zinc chloride, or of zinc hydroxide, which is found attached to the surface of the tube, and under these patches the metal is dezincified. The action of this basic salt is described as regenerative and dependent upon the presence of dissolved oxygen in the water. The experiments of the authors dealt with four alloys, viz. brass, containing copper 70 per cent., zinc 30 per cent.; Muntz metal, containing copper 61 per cent., zinc 39 per cent.; "Admiralty" brass, containing copper 70 per cent., zinc 29 per cent., and tin 1 per cent.; and a special alloy, containing copper 70 per cent., zinc 28 per cent., and lead 2 per cent. As regards resistance to dezincification at 40° and 50° C. the last-named proved superior to the others, the Muntz metal and 70/30 brass being the least resistant. Another interesting and surprising result obtained by the authors is that dezincification does not appear to be due to electrolytic action; they find—contrary to what has been generally believed—that the presence of particles of carbon, or similar materials, even including a plug of pure copper screwed into the tube, does not give rise to local action of this kind. The report contains a detailed account of the experiments upon which these conclusions are based, and thus constitutes a record of work which must be of fundamental importance in the future study of the whole question of corrosion in copper alloys.

Of considerable general interest also was the paper on the intercrystalline cohesion of metals by Dr. W. Rosenhain, F.R.S., and Mr. D. Ewen, of the National Physical Laboratory. The authors of this paper elaborate their theory that the crystals of a metal, forming a crystalline aggregate, are held together by a thin layer of the same metal in the amorphous or undercooled liquid condition. The experimental evidence offered in their first paper they now supplement by evidence obtained from an entirely different direction. In the present paper the relative mechanical properties of the crystals and of the amorphous cement are discussed, and the authors indicate that while at ordinary temperatures the cement would be much harder and stronger than the crystals, at temperatures near the melting point this relation must be reversed, since the undercooled liquid cement must pass into the ordinary fluid condition in a gradual and continuous manner while the crystals will soften suddenly on melting. Just below the melting point, therefore, the theory indicates that the crystals could be pulled apart from one another without undergoing any distortion, thus giving a perfectly brittle fracture—the brittleness being entirely intercrystalline. The authors show such brittle intercrystalline fractures in the case of the purest lead, tin, aluminium, and bismuth, the lead fractures being particularly striking in appearance. At the meeting these data were supplemented by a similar brittle fracture obtained in a bar of the purest gold which had been prepared for the authors by Dr. T. K. Rose, of the Royal Mint. The discussion showed that the theory of an amorphous cement is still received with some reserve, but it was admitted that the accumulation of experimental evidence has considerably strengthened the position of the theory.

The list of papers dealt with at the meeting included nine others, among which those of Dr. T. K. Rose on the annealing of gold, of Dr. W. M. Guertler on the specific volume and constitution of alloys, of Prof. S. L. Hoyt on the constitution of the copper-rich kalchoids, or alloys of copper, zinc, and tin, of Mr. J. H. Chamberlain on volume changes in alloys, and of H. Garland on the metallographic study of some Egyptian antiquities, were of considerable interest. The discussions were in all cases vigorous and full of interest, and the meeting marks a decided advance in the development of the Institute of Metals.

THE PAST SUMMER.

BROADLY speaking, the past summer was essentially dry, generally cool, and particularly sunless considering the small amount of rain.

The reports issued by the Meteorological Office show that for the whole period of thirteen weeks which comprise the summer the mean temperature was below the average in all parts of the United Kingdom except in the north of Scotland, the deficiency being greatest over the east and south-east of England. The mean temperature was higher than in 1912 over the entire kingdom with the exception of the east of England, but it was everywhere much cooler than in the abnormally hot summer of 1911, the difference being greatest in the midland, southern, and eastern districts of England.

The sunshine was deficient over the eastern portion of the kingdom, but generally in excess in the western districts. The hours of bright sunshine were everywhere more numerous than in 1912, but far fewer than in 1911. Taking the British Isles as a whole the total hours of sunshine were 492 in 1913, 373 in 1912, and 679 in 1911.

The average rainfall for the whole of the British Isles for the three summer months—June, July, and August—was 4·47 in. this year, 12·92 in. last year, and 6·27 in. in 1911; the average number of rainy days are thirty-five this summer, sixty-one last year, and thirty-seven in 1911. The rainfall this summer was less in all districts of the United Kingdom than in the dry summer of 1911. In the south-west of England the aggregate summer rainfall was only 39 per cent. of the average, in the north-east of England 44 per cent., and in the midland counties and the south-east of England 45 per cent. The wettest districts were the north of Ireland, 68 per cent. of the normal, north-west of England, 67 per cent., and north of Scotland, 66 per cent.

At Greenwich, which fairly represents England, the weather at the end of May was persistently hotter than at any time during the summer. On six consecutive days the sheltered thermometer rose to 80° or above. Throughout the summer, from June to August, there were only four days with 80° or above, the average number of such warm days for the summer is fourteen, and in 1911 there were thirty-seven days as warm.

The following are the chief meteorological results at Greenwich:—

1913	Temperature							Rainfall			Sunshine	
	Mean highest day	Diff. from average	Mean lowest night	Diff. from average	Mean	Diff. from average	Days above average	Rainy days	Total	Diff. from average	Hours	Diff. from average
	°	°	°	°	°	°			In.	In.		
June ...	71	0	50	0	61	0	12	8	0·61	−1·33	204	+22
July ...	68	−6	52	−1	60	−4	1	12	2·01	+0·12	95	−91
August ...	71	−2	52	−1	62	−1	9	11	2·07	−0·27	143	−34
Summer...	70	−3	51	−1	61	−2	22	31	4·60	−1·45	442	−103

It is seen that June was very dry, but in other respects fairly normal. July had a fairly normal rainfall, but only about one-half of the average sunshine, whilst the temperature was exceptionally low. August was very dry until quite the close of the month, when exceptionally heavy rains fell over the south-eastern portion of England; at Greenwich the total for the last three days of the month was 1·22 in.; both sunshine and temperature were deficient.

CHAS. HARDING.

A MEMOIR ON THE ARTHROPOD EYE.[1]

CONSIDERABLE progress has been made of late towards the elucidation of the structure of the arthropod eye. Prof. G. H. Parker, of Harvard, was the first seriously to attack the more intricate problems of its structure, and his insight was such that most of his work stands unchanged even after the more recent elaborate researches of Hesse, Schneider, and others. In the present paper Dr. Trojan has, in addition to his own researches, verified or corrected the observations of these later investigators, whose work had summarised and illuminated the results of earlier writers.

It will be of profit to mention briefly the interesting points that Dr. Trojan has been able to add to our knowledge. The corneal cells are not "tile-shaped," but they are broader distally than proximally, so that they appear triangular in transverse section. The author is unable to support Schneider's observation that they are four in number, but agrees with Parker and Hesse that there are only two. The structure of the crystalline cells (cone cells) differs in one respect from that described by other writers; the upper part, the "Zapfen," is abruptly cone-shaped distally, and passes between the corneal cells to the facet. The general structure of the retinular cells and rhabdome is as Parker and later writers have described, but Dr. Trojan supports Hesse's opinion (and differs from Parker and Schneider) that there is no "zwischensubstanz" (matrix) between the "stiftchen" (fine rods) composing each half-plate of the rhabdome. The innervation of the rhabdome is effected as Hesse described, the nerve fibrillæ passing up the outer side of the retinular cell, round the nucleus, and terminating on "knöpfchen" as the base of the "stiftchen" composing the lamellæ of the rhabdome. Three optic ganglia are described.

The most important part of the paper is devoted to a study of the pigment of the eye in darkness and light; this, however, is best consulted in the original. There are only two pigment-bearing cells which form a continuous tubular sheath enclosing the whole ommatidium from the crystalline cones to the bundles of nerve fibrillæ under the basement membrane. The author's observations on the movements of the pigments of these cells, and also of the non-pigmented tapetum cells are of considerable interest.

In the course of the paper Dr. Trojan deals successively, under separate headings, with the different elements of the eye, giving an exhaustive anatomical and historical account of each, an arrangement which is lucid and very easy to follow. The plates illustrating the paper are very fine—we wish we could believe they could have been as exquisitely reproduced in this country—though we should have preferred to have had more of the author's own drawings in place of the photographs, beautiful as they are.

Dr. Trojan's paper is an important contribution to the literature of the arthropod eye, not only for the original matter it contains, but also as a critical review of the work of previous observers.

H. G. J.

[1] "Das Auge von Palaemon Squilla." By Dr. E. Trojan. Denk. d. Kais. Akad. d. Wiss. math-naturw. Klasse. Bd. 88. Wien, 1912. 54 pp.+6 pl.

BIOLOGY OF AQUATIC PLANTS.

DR. W. H. BROWN has contributed an important paper on the biology of aquatic flowering plants to *The Philippine Journal of Science* (vol. viii., pp. 1–20), under the title, "The Relation of the Substratum to the Growth of Elodea." He confirms the statements of previous observers that in this and in other submerged plants there is a "transpiration current" of water up the vessels of the stem, but his experiments lead to the conclusions that this current is simply a necessary consequence of the physical construction of the plant, and that the passage of water through a submerged plant does not show that the movement is of advantage to the plant by causing condensation of nutrient salts or that the roots are of advantage as absorbing organs.

Dr. Brown gives tables showing the relative growth of Elodea with and without addition of carbon dioxide to the water, in tap water, and in Knop's solution, with and without soil, rooted in and simply anchored over soil or sand, &c., and summarises the results as follows. Sufficient carbon dioxide to keep Elodea growing or even alive does not diffuse from the air into the water during winter and spring; the substratum probably serves as an important source of this gas. Elodea is not dependent on its roots for absorption of mineral salts, the chief function of the roots being to anchor the plant to the soil, which is advantageous when the soil contains organic matter and gives off carbon dioxide; plants rooted in good soil grow better than those anchored over the same soil. When carbon dioxide was supplied by a generator instead of by the soil, rooted and anchored plants grew about equally well; with similar soils, and no external supply of carbon dioxide, floating plants grew better than rooted ones, the air being in this case the source of carbon dioxide.

The author's work is of great interest with reference to the relation between the growth and abundance of plankton organisms (which form a large proportion of the food of fishes) and of larger water plants, and has obvious economic bearings; for instance, his experiments would seem to show that the larger submerged plants compete with the plankton algæ for both carbon dioxide and mineral salts, and must therefore be detrimental to their growth.

F. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—A course of twelve post-graduate lectures on "Conductors for the Electrical Transmission of Energy" will be delivered at University College by Prof. J. A. Fleming, F.R.S., beginning on October 20. The course, which is intended for post-graduate students and for telegraphic and electrical engineers, engaged in practical work, will be divided into two parts, which may be attended separately. Part i. will be devoted to "Telegraph and Telephone Conductors," and part ii. to "Electric Light and Power Conductors."

The Maharaja of Jaipur has made a contribution of three lakhs towards the establishment of a Women's Medical College at Delhi.

Among recent appointments at American universities we notice the following:—Dr. A. H. Ryan to the chair of physiology in the medical department of the University of Alabama; Dr. J. A. Bullitt to the chair of pathology in the University of North Carolina.

Mr. D. C. Matheson, at present on the veterinary staff of the Board of Agriculture and Fisheries, and formerly connected with the veterinary school of the University of Liverpool, has been appointed to the chair of pathology and bacteriology in the Royal (Dick) Veterinary College, Edinburgh.

It is stated in *The Lancet* that of the scholarships to be founded at Aberdeen University by the bequest of Mr. W. Robbie (briefly referred to in our issue of August 21) one is to be for chemistry. The principal of the sum left to the University by Mr. Robbie is to be kept intact, and the interest used in providing perpetual scholarships.

An alarming outbreak of fire took place on Friday morning last at Dulwich College, damage being done to the extent of about 300*l*. The fire appears to have been the work of Suffragettes. The scene of the outrage was one of the chemical laboratories on the first floor of a block of buildings devoted partly to the engineering section of the college and partly to chemistry. Before the fire could be extinguished a lecture platform was destroyed, the floor of the room badly damaged, and the windows broken by the heat.

The recently published reports for 1911–12 from those universities and university colleges in Great Britain which are in receipt of grants from the Board of Education show that, in the twenty-five institutions of higher education concerned, there were 22,895 students, excluding 238 who were preparing for matriculation. In English colleges there were 7827 full-time students, 3370 part-time day students, and 7295 part-time evening students. Of this number it appears that 1596 were engaged upon post-graduate work. In Wales there were 1377 full-time students and 343 part-time students, none of them attending in the evening. Of the total number of full-time students admitted during the session 1911–12 to English colleges, 4·6 per cent. were under seventeen years of age, 11·9 per cent. between seventeen and eighteen years of age, 27·6 between eighteen and nineteen years of age, and 55·9 per cent. more than nineteen years old. In Wales, 33·7 per cent. of the students were between eighteen and nineteen, and 54·1 per cent. more than nineteen years of age.

A copy of the calendar of the day and evening classes to be held at the Battersea Polytechnic during the session which begins on September 16 has been received. Courses have been arranged both during the day and in the evening in preparation for degrees in science, engineering, and music at the University of London. In the day technical college, full-time courses are arranged in mechanical, civil, electrical, and motor engineering, architecture, and building, and chemical engineering, each covering a period of three years, at the end of which time students passing the necessary examinations are awarded the polytechnic diploma. There are also courses in mathematics, physics, chemistry, and botany. The training department of domestic science offers two, three, or four year courses in preparation for the teachers' diplomas in domestic subjects. In the evening, classes have been arranged to meet the needs of every class of student. Science, technology, commerce, art, and literature are all to be taught in a thoroughly practical manner, and the social and physical education of the students is not neglected.

The new session of the Sir John Cass Technical Institute, Aldgate, E.C., will commence on September 22. The syllabus of classes, which has reached us, shows that the educational needs of the district are being cared for admirably. In connection with the higher technological work, several new departures are being made for the coming session. The curriculum in connection with the fermentation industries has been much developed, and now includes courses of instruction on brewing and malting, bottling and cellar management, brewery plant, and on the microbiology of the fermentation industries. A connected series of lectures dealing with the supply and control of power has also been arranged to meet the requirements of those engaged in works connected with chemical, electrical, and the fermentation industries. These will comprise a course of lectures on the supply and control of liquid, gaseous, and solid fuel, a course on electrical supply and control, and a course on the transmission of power. The courses in the metallurgical and other departments will be of the same character as in previous years, and the object will be to meet the needs of the industries in the districts served by the institute.

The ninth annual report of the Education Committee of the County Council of the West Riding of Yorkshire is an excellent account of a good year's educational work. From the section dealing with higher technical education we learn that in consideration of the grants received from the County Council the Universities of Leeds and Sheffield have been engaged in the organisation and supervision of classes in coal mining, the Leeds University in the area of the West Yorkshire Coalfield, the Sheffield University in the area of the South Yorkshire Coalfield; and each University has made provision for the training in mine gas testing, of persons selected by the Education Committee as prospective teachers of this subject. The Joint Agricultural Council of the three Ridings of Yorkshire have continued the work connected with education and instruction in agricultural subjects, acting through the agricultural department of Leeds University, on the same lines as before. The two outstanding features of the year's work in the technical and evening schools which call for special mention have been, first, a successful summer meeting of teachers in evening schools, and secondly, a considerable development in regard to the provision of evening classes for adults in non-vocational subjects.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, August 25.—M. A. Chauveau in the chair.—Kr. **Birkeland**: Remarks on the attempts made by Hale to determine the general magnetism of the sun. The results recently published by Hale are at variance with the author's views, if the general magnetism of the sun is similar to that of the earth. The objection made by Hale to the theory of local vortices is discussed. According to the author's researches, the magnetic moment of the sun is of the order of 10^{25} C.G.S. units, and the magnetisation is directed in a sense contrary to that of the earth.—

Georges **Claude**: The maintenance of temperatures about −211° C. by the use of liquid nitrogen. An admission of priority to Sir James Dewar.—R. **Swyngedauw**: The integration of the equation giving the distribution of the density of an alternating current in cylindrical conductors.—P. Th. **Muller** and R. **Romann**: The dissociation of good electrolytes and the law of mass action.—J. **Bougault**: The isomerisation of the α-hydroxy βγ-unsaturated acids into γ-ketonic acids. The views of Fittig, Thiele, and Erlenmeyer on this well-known isomeric change are discussed. The author puts forward experimental evidence in favour of the following simplified scheme:—

$$R.CH = CH.CH(OH).CO_2H \longrightarrow R.CH(OH).CH = CH.CO_2H \longrightarrow R.CO.CH_2.CH_2.CO_2H.$$

—Em. **Bourquelot** and M. **Bridel**: The biochemical synthesis of glucosides of polyvalent alcohols; the α-glucosides of glycerol and glycol. Stanislas **Meunier**: An unrecognised point in the fossilisation of organic débris.

BOOKS RECEIVED.

Research in China. (In three volumes and Atlas.) Vol. iii.: The Cambrian Faunas of China, by C. D. Walcott. A Report on Ordovician Fossils collected in Eastern Asia in 1903–04, by S. Weller. A Report on Upper Paleozoic Fossils collected in China in 1903–04, by G. H. Girty. Pp. vii+375. (Washington, U.S.A.: Carnegie Institution.)

The Infinitive in Anglo-Saxon. By Prof. M. Callaway, Jr. Pp. xiii+339. (Washington, U.S.A.: Carnegie Institution.)

Botanical Features of the Algerian Sahara. By W. A. Cannon. Pp. vi+81+36 plates. (Washington, U.S.A.: Carnegie Institution.)

The Diffusion of Gases through Liquids and Allied Experiments. By Prof. C. Barus. Pp. vii+88. (Washington, U.S.A.: Carnegie Institution.)

The Fermentation of Cacao. Edited by H. H. Smith. Pp. lvi+318. (London: J. Bale, Sons, and Danielsson, Ltd.) 10*s*. net.

The Poisonous Terrestrial Snakes of our British Indian Dominions (including Ceylon), and How to Recognise Them, with Symptoms of Snake Poisoning and Treatment. By Major F. Wall. Pp. xiv+149+iv. Third edition. (Bombay: Bombay Natural History Society; London: Dulau and Co., Ltd.) 3 rupees.

A Handbook for Birmingham and the Neighbourhood. Prepared for the eighty-third Annual Meeting of the British Association for the Advancement of Science. Edited by Dr. G. A. Auden. Pp. vii+637. (Birmingham: Cornish Bros., Ltd.) 3*s*. 6*d*. net.

Gruppenweise-Artbildung unter spezieller Berücksichtigung der Gattung Oenothera. By Prof. Hugo de Vries. Pp. viii+365+22 plates. (Berlin: Gebrüder Borntraeger.) 22 marks.

Chemical Technology and Analysis of Oils, Fats, and Waxes. By Dr. J. Lewkowitsch. Fifth edition, entirely rewritten and enlarged. Vol. i. Pp. xxiii+668. (London: Macmillan and Co., Ltd.) 25*s*. net.

Vectorial Mechanics. By Dr. L. Silberstein. Pp. viii+197. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Principles of Thermodynamics. By Prof. G. A. Goodenough. Second edition, revised. Pp. xiv+327. (London: Constable and Co., Ltd.) 14*s*. net.

Sinopsis de los Ascaláfidos (Ins. Neur). By R. P. Longinos Navás, S.J. Pp. 99+2 plates. (Barcelona: Institut d'Estudis Catalans.)

Abhandlungen der K.K. Geologischen Reichsanstalt. Band 16. Heft 4. Beiträge zur Kenntnis der Schichten von Heiligenkreuz (Abteital, Südtirol). By Dr. E. Koken. Pp. 43+6 Taf. (Vienna.) 12 kronen.

Handbuch der Morphologie der Wirbellosen Tiere. Edited by A. Lang. Erster Band. Protozoa. Lief. 2. Pp. 161–320. (Jena: G. Fischer.) 5 marks.

Minds in Distress. By Dr. A. E. Bridger. Pp. xii+181. (London: Methuen and Co., Ltd.) 2*s*. 6*d*. net.

Pheasants and Covert Shooting. By Capt. A. Maxwell. Pp. ix+332+16 plates. (London: A. and C. Black.) 7*s*. 6*d*. net.

Annals of the Astrophysical Observatory of the Smithsonian Institution. Vol. iii. Pp. xi+241. (Washington.)

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*" To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

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THURSDAY, SEPTEMBER 18, 1913.

THE STRUCTURE OF THE ATMOSPHERE IN CLEAR WEATHER.

The Structure of the Atmosphere in Clear Weather: a Study of Soundings with Pilot Balloons. By C. J. P. Cave, M.A. Pp. xii + 144. (Cambridge: The University Press, 1912.) Price 10s. 6d. net.

MR. CAVE'S book is a welcome addition to the valuable contributions of amateurs to the common stock of scientific knowledge, and is the more welcome as the first book on this special subject. The investigation of the upper air is of such interest and the incidental problems which it presents are so numerous, so attractive, and, in these days of flying, so practical, that it is a matter of some surprise that there are not found more men of leisure to follow the notable examples of Prof. Lawrence Rotch and M. Teisserenc de Bort in the investigation of the free atmosphere. Mr. Cave in his introduction refers to the circumstances in which he began the study of the subject. As a matter of history, they can be traced to a letter by the present writer in *The Times* asking for the cooperation of yachtsmen in the exploration of the air over the sea by means of kites. Since that letter appeared we have had to chronicle the division of the atmosphere into two distinct layers, an upper layer, the *stratosphere,* in which there is little or no variation of temperature in the vertical, but sensible variation from day to day, or along the horizontal, and a lower layer, the *troposphere,* in which the variation of temperature is greatest in the vertical and relatively small along the horizontal. At the boundary between the two layers which is found at different heights in different regions, and on different occasions according to the barometric pressure, there is generally a slight inversion in the fall of temperature with height. Ten kilometres may be taken as a rough and ready estimate of the average thickness of the troposphere with the understanding that there is a latitude of three or more kilometres to be allowed in either direction according to circumstances.

With the progress of the general investigation of the upper air attention has been directed especially to the observation of air-currents at different levels by means of pilot balloons watched through theodolite-telescopes of special construction, introduced by M. de Quervain. Mr. Cave's book gives a comprehensive account of the methods and results of work of this character based upon his own experience at Ditcham Park and elsewhere. The apparatus is simple and less expensive than that required for the determination of temperatures:—a balloon which need not be large enough to carry recording instruments, some hydrogen, and accessories, two theodolites to be used simultaneously from two ends of a base for the observation of the altitude and azimuth of the rising balloon at the end of each minute or half minute from the start. One of the theodolites may be dispensed with if the observer knows with reasonable accuracy the rate of ascent of the balloon, and, as appears from one of Mr. Cave's chapters, this condition may be assumed without fear of losing the characteristic features of the ascent. In fact, observations of pilot balloons with one theodolite have been asked for as part of an international enterprise. The reduction of the observations is laborious, as each sounding entails the solution of many triangles, but with the judicious use of a slide rule and tables as described on p. 12, the labour is apparently not intolerable. The results of two hundred soundings in 1907, 1908, and 1909, with one in 1910 involving the solution of 8000 triangles, are given in the book. They are classified according to certain types of structure. For each sounding the velocity and direction of the horizontal motion of the air at each half kilometre are given in tables on pp. 84–107, and they are illustrated by a number of diagrams showing the variation of direction and velocity with height, accompanied by the weather maps which represent the distribution of surface pressure on the occasions of the ascents. A word of praise must here be given for the excellence of the arrangement and printing of the tables and of the diagrams and maps.

The order of the book also deserves remark. Mr. Cave has departed from the usual course in not taking the mean values of all the fish that have come into his net. He has sorted out his catch before submitting it to digestion. In fact, there are, if we recollect rightly, no mean values anywhere in the book. In the present state of our knowledge this decision is a wise one, for until the variations are reduced to those of observation alone, a mean value often conceals more truth than it reveals, and is sometimes actually misleading.

The first step in the discussion is to form a selection of types of structure. These are excellently illustrated by photographs of cardboard models.

The use of pilot balloons is subject to some obvious limitations. There is no little difficulty in pursuing a balloon with a theodolite for great distances. On one favourable occasion Mr. Cave kept a balloon in view until it was forty miles away, but ordinarily a sounding comes to an end by losing sight of the small speck in the field of view of the theodolite either by a trick of eyesight or by the accident of clouds, long before any such distance has been reached. Consequently, the investigation is limited to clear weather, and for the most part to the lower layers of the atmosphere. The lower half of the troposphere, say, up to five kilometres from the surface, is the region specially under observation, but when the sky happens to be clear the investigation can be extended to much greater heights. Mr. Cave gives twelve examples of series of observations beyond 11 kilometres, and one up to 18 kilometres. He is therefore able to devote a chapter to the winds of the upper layer, the stratosphere, and he supports the general conclusion that the wind falls off rapidly as the boundary of the stratosphere is approached and passed, though we must wait to learn whether this result is characteristic of the stratosphere or merely characteristic of the weather when the stratosphere comes under observation.[1]

Useful chapters will be found devoted to methods of observing and their accuracy, and to the rate of ascent of balloons, with an examination of the effect thereupon of the orographical features of the neighbourhood. The author then takes up the meteorological applications of his results. This section takes the form, for the most part, of a study of the relation of the strength and direction of currents aloft to the distribution of pressure and temperature at the surface, and leads up to an important diagram on p. 75 showing the upper winds in relation to a hypothetical distribution of high and low pressure at the surface. The diagram represents increased velocity aloft in the westerly currents of a "low," and in the south-westerly and north-westerly currents of a "high," but a diminished velocity in the easterly wind of a "high." To judge by the text, an unchanging current might have been represented in the more central area where there is little pressure gradient, and certainly a reversal of the north-easterly current on the south-eastern side of a high-pressure area. But the most striking feature of the diagram is a strong north-westerly upper current increasing with height (across the surface isobars and the south-westerly surface winds) from the central region of a "low" to the eastern region of the neighbouring "high." This noteworthy current which must be closely associated with the dynamical structure of the atmosphere is rightly selected as one of the types of structure to which attention is specially called. It is in line with observations of cirrus cloud in front of a low-pressure area.

[1] The falling off of wind with height in the stratosphere can be shown to be a logical consequence of the higher temperature of the region of lower pressure.

The relations to the sequence of weather on many occasions are set out in detail, but the results are not easily generalised except in the special case of the reversal of the current over a north-easterly wind, which is shown in many instances to be the precursor of rain and thunderstorms.

Some attention is given to the relation of the direction and strength of the wind in the upper air to the pressure gradient at the surface, assuming that the gradient wind is tangential to the isobars. As regards direction, there are useful diagrams showing the relation of the gradient directions to the surface winds for the three types of structure, viz.: (1) "solid current," (2) increase of velocity aloft, and (3) decrease of velocity aloft; the last shows the decreasing winds to be limited to cases of surface wind between north and south-east. As regards strength, gradient velocities are calculated from the usual formula:

$$V = \gamma/(2\omega\rho \sin\lambda),$$

and the increase of velocity with height for some situations is attributed to an increase of gradient deduced from the distribution of temperatures in the lowest layers indicated in the published weather-charts.

The increase of gradient is calculated from the surface temperature by a rough and ready formula which, considering the local influences upon temperature and other circumstances, is sufficiently accurate for Mr. Cave's immediate purpose; but it may be useful to give here a more accurate formula, to which that used by Mr. Cave approximates. Neglecting the effect of humidity, which is certainly small and usually unknown, the *increase* of pressure difference in millibars for h metres of height measured from any level is given by the formula:

$$\Delta p_h - \Delta p = 0{\cdot}0342 h \frac{p}{\theta}\left(\frac{\Delta\theta}{\theta} - \frac{\Delta p}{p}\right),$$

where p is the pressure at one place, $p + \Delta p$ that at another on the same level, θ and $\Delta\theta$ are the temperature and temperature difference, and Δp_h is the pressure difference at h metres above the given level.

Near the surface p/θ is approximately equal to 3, so that for the first k kilometres from the surface the formula would become approximately:

$$\Delta p_k - \Delta p_0 = 100k\left(\frac{\Delta\theta}{\theta} - \frac{\Delta p}{p}\right).$$

The approximate formula used by Mr. Cave is practically identical with this, except that the term $\Delta p/p$ is omitted. The omitted term may be sufficiently small to be neglected for the surface layers when Δp is not large, because p is numerically of the order of 1000 in that region, but $\Delta p/p$ cannot be neglected in calculations requiring greater accuracy, or in the upper reaches of the atmosphere, where p has a much smaller value because θ does not fall proportionally to the fractional fall of p.

In considering any physical explanation of the structure of the atmosphere, the difference $\Delta p/p - \Delta\theta/\theta$ is an important quantity. In fact, as a rule, it appears that, somewhere or other in a vertical section of the troposphere (where $\Delta\theta$ and Δp are of the same sign), in consequence of the variations in the magnitudes involved, the quantity $\Delta p/p - \Delta\theta/\theta$ *becomes zero and changes sign*. To that curious circumstance is due the dominance of the influence of the stratosphere upon the dynamics of the surface layers, although it only represents about a quarter of the whole mass of the atmosphere. In the stratosphere Δp and $\Delta\theta$ are of opposite signs, and their influences in the production of pressure difference reinforce each other. Hence in the stratosphere, pressure differences are rapidly built up, while in the troposphere changes are capricious and contradictory.

But fortunately these considerations are, so far as can be judged, of little importance in the cases to which Mr. Cave has applied his rough and ready formula, and do not affect the general accuracy of his conclusions.

For the practical study of the dynamics of the atmosphere we are largely dependent upon observations with pilot balloons. They may be taken as supplementing observations of clouds, and, in due time, both must be brought into relation with the observations of pressure and temperature obtained from registering balloons. It is in many ways unfortunate that the track of a registering balloon cannot always be followed by a theodolite or otherwise determined. As it is, we often get our kinematical conditions from one occasion, and our baric and thermic conditions from a different one.

Something may be done to bring the two together by means of observations of cloud-sequence, which can be observed on either occasion. At present these have hardly come within the range of meteorological work. Few observers are effectively conscious of the rapidity of the changes which are indicated by clouds, and which must be the results of the distribution of pressure, temperature, and wind.

In the book before us little is said of the association of cloud-forms and cloud-changes with the variations of the structure of the atmosphere disclosed by pilot balloons, but that part of the subject has great possibilities, and this leads us to express the hope that in a subsequent edition of this interesting work Mr. Cave may be able to give us the benefit of his experience in that direction also.

W. N. SHAW.

SOCIOLOGY AND MEDICINE.

(1) *The Task of Social Hygiene.* By Havelock Ellis. Pp. xv+414. (London: Constable and Co., Ltd. 1912.) Price 8*s*. 6*d*. net.

(2) *The People's Medical Guide: Points for the Patient, Notes for the Nurse, Matter for the Medical Adviser, Succour for the Sufferer, Precepts for the Public.* By Dr. John Grimshaw. Pp. xx+839. (London: J. & A. Churchill. 1912.) Price 8*s*. 6*d*. net.

(1) THE title of this book somewhat masks the nature of its contents, for by "social hygiene" the author means to convey the study of those things which concern the welfare of human beings living in societies. The various chapters, or essays as they practically are, include such varied subjects as the changing status of woman and the woman's movement, eugenics and love, religion and the child, the falling birth-rate, sexual hygiene, war against war, international language, and others. The author generally presents the two points of view, supporting them by quotations and summaries from many sources. The essays are interesting reading, but at the end leave us somewhat in doubt as to what would be for the best, or what the writer considers would be best.

(2) This book covers almost the whole range of subjects comprised within the scope of the practice of medicine and surgery, including the specialities such as diseases of the throat and eye. The information given seems generally to be accurate, is imparted in simple language, and important points are frequently driven home by some terse sentence, *e.g.* "a tooth in the head is worth two on the plate" (p. 57). Some capital sections are given on the management of children, diets and cooking, and physical exercises. The matter does not always seem to come quite in the right place, and simple domestic remedies and treatment may be omitted; for example, that common complaint of children, "child crowing," or "spasmodic croup," is scarcely noticed under children's ailments, but is relegated to the chapter on diseases of the throat, and it is certainly by no means "invariably" associated with rickets.

We think that the compass of the work is somewhat beyond that necessary or desirable for the general public, but the volume would serve as an excellent book of reference for the district nurse, health visitor, missionary, ship's captain, and the like.

R. T. H.

OUR BOOKSHELF.

British Rainfall, 1912. On the Distribution of Rain in Space and Time over the British Isles during the Year 1912, as recorded by more than 5000 Observers in Great Britain and Ireland, and discussed with Articles upon various Branches of Rainfall Work. By Dr. H. R. Mill, assisted by C. Salter. Fifty-second annual volume. Pp. 96+372. (London: E. Stanford, Ltd., 1913.) Price 10*s*.

THE plan of this valuable annual volume remains almost exactly as before; it is well known to many of our readers, and is welcomed by meteorologists and others for its comprehensiveness and the scrupulous care exercised in dealing with matters of detail. Part i. is devoted mainly (1) to the unprecedented rainstorm of August 25–26 in East Anglia, the area being now extended to the whole of England and Wales. The rainfall exceeded 7·5 in. over about sixty-seven square miles, with a small patch where more than 8 in. fell, between Norwich and Brundall. The weight of precipitation over England and Wales is estimated at 4473 million tons. (2) the wettest summer in England and Wales. The rainfall was not exceeded during the last fifty years; in August the amount in south England was more than three times the average over large areas. The general rainfall for June-August was 78 per cent. above the normal. Part ii. deals with the rainfall for the year, and includes the observers' remarks on the weather, with heavy falls and monthly and seasonal rainfall, illustrated by maps. The year was a wet one; expressed in percentages the totals were: England, 123; Wales, 119; Scotland, 111; Ireland, 108; British Isles, 115. Part iii. contains the general tables of total rainfall at 5272 stations; maps of the river-divisions are now given, with the tables for each of the twenty-three large divisions of the country. We notice with regret that this useful and unique organisation is not yet self-supporting, and that the deficit has to be met by the director; further, that owing to the continual strain of the work, Dr. Mill has to take a complete temporary rest, during which time Mr. Mossman, of the Argentine Meteorological Office, will undertake the editorship of the publications.

(1) *Die Süsswasser-Flora Deutschlands, Osterreichs und der Schweiz.* Herausgegeben von Prof. A. Pascher. Hefts. 2, 3, 9, and 10. Price 5, 1.80, 1.50, 4 marks.
(2) *Die Süsswasserfauna Deutschlands eine Exkursions-fauna.* Herausgegeben von Prof. Dr. Brauer. Heft. 14. (Jena: Gustav Fischer, 1912–13.) Price 7 marks.

THESE little monographs on the fresh-water flora and fauna of Germany, Austria, and Switzerland are issued under the general editorship of Prof. Pascher and Prof. Brauer respectively. The series on the fauna is issued in nineteen parts, extending from the Mammalia to the Hydrozoa; that on the flora in sixteen parts, of which the first twelve and part of the thirteenth deal mostly with microscopic forms, the remainder with fungi, mosses, lichens, &c.; a volume on the Protozoa does not seem to be included. The volumes range in price from 1.50 marks to 7 marks, are purchasable separately, and are written by well-known authorities on the subjects of which they treat. Each volume commences with a general description of the particular group dealt with, methods of investigating and preserving the organisms, and a brief list of the principal works and papers on the subject, after which follows a systematic description of species, diagnoses of genera, &c.

(1) These volumes deal with several groups of flagellated micro-organisms (Heft. 2 and 3), including *Euglena*, diatoms (Heft. 10), and the Zygnemales (Heft. 9), *i.e.*, chlorophyl-green, cylindrical-celled algæ, such as *Spirogyra*. All the volumes seem very complete, and that on the diatoms should serve as a very useful handbook on this interesting group of micro-organisms.

(2) This volume deals with the Rotatoria and Gastrotricha. A good account is given of rotifer structure, and the diagnostic tables and descriptions of species are excellent.

All the volumes are profusely illustrated, *e.g.*, no fewer than 379 illustrations are allotted to the diatoms and 474 to the rotifers, many comprising two or more figures.

We believe that these series will be of the greatest service to the field-naturalist and others.

R. T. H.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Nature and Treatment of Cancer and Malaria.

MAY I ask your courtesy for a brief reference to the article by Dr. C. W. Saleeby on the International Medical Congress (NATURE, August 14, pp. 608–9)? Dr. Saleeby notes, that recent research is tending in the direction of the views advanced by me some few years ago. How long will yet elapse before these views as to the germinal origin, trophoblastic (asexual) nature, and enzyme or pancreatic treatment of cancer are "generally accepted" cannot be said. But whenever that time does arrive, mankind in general and medical mankind in particular will have no other refuge against the ravages of cancer than its treatment with genuine strong injections of trypsin and amylopsin. Scientifically, what evidences are there of this? In the first place, among others, three successful cases treated by Major Lamballe were described in my book on cancer, published two years ago. It is quite four years since the patients were treated. Two of them are certainly alive and well, and I believe that this is also so with the third. More recently, I have pointed out, in a paper on the occurrence of dextro-rotatory albumins in organic nature, noticed not long ago in your columns, that the asexual generations, such as the malaria parasite, &c., which induce disease, are the same in nature as cancer-cells, and have foretold their total destruction by the ferments, trypsin and amylopsin. In a memoir, which is about to be published, Major F. W. Lamballe, R.A.M.C., has demonstrated the scientific truth of this. He has shown in a way which must carry complete conviction, that cases of benign and malignant tertian malaria, even very grave cases with cerebral symptoms, in all of which, as his results show, quinine had proved quite useless to stem the disease and to prevent relapses, from *one to three* injections of pancreatic enzymes sufficed not merely to kill all the parasites, but to cure the patient. Relapses in the patients—which had been the rule in very nearly all the cases—did not occur after this brief treatment, and the men (British soldiers) were able to return to duty *at once*, even in some instances on the day of the second or third injection. That is to say—and it is a matter for great scientific satisfaction—the original work, which I began in 1888, has now resulted in the easy and complete conquest of malaria. What this means can be understood from the facts concerning the treatment of malignant malaria, which at present is the rule in the Army. This entails a course of treatment by quinine lasting at least *four months*, and very often, if not always, even then the patient is not cured. But I understand that during this time the soldier is regarded as unfit for active service, and sometimes 25 per cent. of a regiment stationed in the tropics may be in this condition. In contrast to this the pancreatic treatment of malignant malaria in the hands of Major Lamballe entails not more than *three injections*, costing at the outside three shillings, it need not last *two weeks*, and the patient can return to duty at once, and so far as we know is then free from all danger of relapse, but *not* immune to a new infection. The facts here outlined indicate that, properly applied, that which cures malignant malaria *must* cure cancer.

J. BEARD.

8 Barnton Terrace, Edinburgh, August 30.

[I AM delighted that my brief reference to Dr. Beard's work should have elicited this interesting letter. He might also have referred to the astonishingly successful treatment of surgical tuberculosis by the pancreatic ferments, which was reported upon by Baetzner in the special tuberculosis number of *The Practitioner* recently. (Being abroad, I cannot give the reference.) When Dr. Beard refers to the malaria parasite as an asexual generation, he must, of course, be thinking of only one-half of its complete reproductive cycle. It would be interesting to make clinical observations as to the action of trypsin and amylopsin upon the sexual and asexual stages of these parasites respectively. As for cancer, I shall never be able to believe that the good results I saw under Dr. Beard's method of treatment six years ago were not causally connected with it. And if it be true, as is now asserted, that the leucocytes, our defenders against morbid cells, normally produce trypsin, perhaps the last has not been heard, after all, of this daring and original theory of Dr. Beard.—C. W. SALEEBY.]

Note on the Dicynodont Vomer.

IN a paper on Dicynodon now being printed by the Royal Society we have already described the bone which Dr. Broom now regards as the "typically mammalian median vomer." It is the bone which he has described previously as the anterior continuation of the basisphenoid, but without recognising the groove on the dorsal surface. No trace of a suture exists between it and the basisphenoid. To us it seemed, as stated in our paper, that the form of this bone, so far from confirming Dr. Broom's views, rendered his interpretation of the grooved bone in Diademodon even more doubtful than before.

That the bone generally recognised as the vomer in Dicynodon had a paired origin we readily admit, and we had already set forth reasons for this view in a paper now in MSS. on the structure of the skull in a small unnamed Dicynodont genus; as we have pointed out in our paper on Dicynodon, the vomer is paired in the guinea-pig, and had probably a paired origin in mammals.

IGERNA B. J. SOLLAS.
W. J. SOLLAS.

Oxford, September 6.

An Aural Illusion.

I AM not aware that the following curious particular has been noticed.

If a sounding body has a velocity greater than that of sound in air, it will outstrip its previous sounds as it goes, and leave them to follow in its wake. Let it be supposed that such a body ceases sounding directly it passes an observer. In this case the sound waves of the greatest intensity will be the first to act, and those of the least intensity, the last. Hence the modulation of the sound will be reversed, and will have the character of a *diminuendo*, which we associate with sound that comes from a receding body. In such circumstances, therefore, it would seem to the observer that the source of sound had been travelling away from, instead of towards, him; an illusion touching the swell of the sound, and so the apparent direction of the sounder, quite distinct from those pitch effects which are duly taken cognisance of by Doppler's principle.

NORMAN ALLISTON.

THE NINTH INTERNATIONAL PHYSIOLOGICAL CONGRESS.

THE triennial International Physiological Congress, which was held at Groningen on September 2 to 6, was unanimously voted by those who attended it to be one of the most successful scientific congresses held during the present year. The number of workers engaged in physiological investigation being not very large, the congress, although larger than might have been anticipated, was of manageable size, and since physiologists on the whole are not a fluctuating body, everyone felt at ease and *en famille*.

It would be impossible to speak too highly of the admirable manner in which the president, Prof. Hamburger, with his characteristic precision, provided for the welfare and convenience of all those who attended the congress and who gave demonstrations in the laboratories; these latter are beautifully equipped, and leave nothing to be desired.

To English physiologists this particular physiological congress is of especial interest, since it is now twenty-five years since the congress was founded at the suggestion of the Physiological Society; the late Sir Michael Foster, its first president, was one of those who was most directly connected with its foundation, and it was as a fitting tribute to his labours that his portrait was chosen as the frontispiece for the special Festschrift, edited by Prof. Hamburger and Dr. Laquer. In this volume an excellent *résumé*, arranged according to subject, is given of the work of the congress during the past twenty-five years; this is preceded by the opening address of the president, Prof. Hamburger, at the present congress.

The congress numbered about 400 members, of whom about sixty were British, and the social events were numerous. On September 1 the visitors received in De Harmonie a warm welcome from the Dutch physiologists and the Medical Association of Groningen. The following evening there was a reception in the large hall of the University buildings by the Queen's representative and the Dutch Government. On Wednesday, at the "Sterrebosch" Park, the guests enjoyed the hospitality of the municipality of the town, and on the next day, at the Paterswolder Lake, that of the Ex-Senator M. J. E. Scholten. On Thursday evening there was also an excellent entertainment at the theatre and in De Harmonie. On the last evening a banquet terminated the congress. But the hospitality was not confined to the above-mentioned events; many members enjoyed private hospitality during their stay, and, as stated by Prof. Starling, all the people in the town were so cordial that "we felt that we were not merely the guests of the physiologists, but of every bargee and every tram conductor in the town." There was a special ladies' committee, and several excursions were arranged for the ladies who attended the congress.

To commemorate the occasion of the congress, the Dutch medical journal, *Nederlandsch Tijdschrift voor Geneeskunde,* issued a special number, largely devoted to physiological communications, and to the history of the development of physiology in Holland. The same journal also had a special medal struck, and duplicates were presented to all members of the congress. The medal bore the portrait of the famous Dutch physiologist, Donders, executed by the well-known sculptor Pier Pander; on the back were the words, "Aan de leden van het IXe Intern. Physiologen Congres. te Groningen, aangeboden door het Nederlandsche Tijdschrift voor Geneeskunde September MCMXIII."

("Offered to the members of the IXth International Physiological Congress in Groningen, by the Nederlandsch Tijdschrift voor Geneeskunde September 1913.")

The demonstrations and communications were very numerous, and it was not possible for one person to see and hear much more than one-third of the whole programme, which occupied most of the mornings and afternoons. The English physiologists contributed largely to the demonstrations, which, as in the meetings of our Physiological Society, had precedence over merely oral communications. The demonstrations of Profs. Starling (heart-lung preparation) and Sherrington (rhythmic reflex produced by antagonising reflex excitation by reflex inhibition) are familiar to English physiologists. A demonstration which attracted much interest was that of Prof. Abel and Dr. Rowntree, of Baltimore; this consisted in an apparatus for what may be termed "vividiffusion," and must be accounted one of the most distinct improvements in physiological technique which have been seen in recent years. The apparatus is called the "artificial glomerulus," and consists of a series of collodion tubes arranged in parallel, and surrounded by warm Ringer's solution; there may be from sixteen to forty-eight tubes in the apparatus, and through this system blood from a chloralosed and hirudinised animal is led. The blood flows out from an artery or vein (*e.g.* from the carotid artery, or from one of the tributaries of the portal vein) through the apparatus, and returns again to the circulation of the animal by a vein (*e.g.* the external jugular vein or the femoral vein). Such a circulation can be carried out under sterile conditions, and may be continued for sixteen hours with ease, and in favourable circumstances for much longer. At intervals the fluid surrounding the collodion "glomerulus" is run off and replaced by fresh Ringer's solution. The solution thus run off will contain all the diffusible substances of the blood other than the saline constituents of Ringer's solution, and on evaporation these may be recovered. In this manner it is possible to detect the presence of substances which are only present in minute traces in the circulating blood; thus, at the end of sixteen hours considerable amounts of amino-acids and of urea can be recovered from the dialysate; sugars and a polypeptide substance are also present. It is worthy of note that, as regards efficiency, the artificial kidney thus made compares very favourably with the animals' own kidneys; thus, when salicylates are given, the artificial glomerulus may excrete as much or more than the kidneys in a given time. It is hoped that a surgical application of this principle will prove of value. The applications of the method to the study of intermediary metabolism are obvious, and interesting results have already been obtained in this direction.

Another interesting demonstration was that of Prof. Benjamin Moore and Dr. Webster, who showed that when carbon dioxide was passed through solutions of such inorganic colloids as uranic oxide or ferric oxide in high dilution, in presence of sunlight or of light from the mercury arc, formaldehyde is formed, and may be detected by Schryver's test. They discussed the relation of this phenomenon to the question of the first appearance of organic matter on the globe.

Dr. Carlson, of Chicago, showed that it is easy to demonstrate on man the presence of rhythmic and of so-called "tetanic" contractions of the walls of the stomach during fasting. For this purpose two long indiarubber tubes are swallowed until their lower ends reach the stomach. One of the tubes serves for the introduction of substances into the stomach, and the other ends in a thin rubber sound which is inflated, and which, when connected with a water manometer, serves to record the contractions of the stomach. Dr. Carlson maintains that these contractions give rise to the sensation of hunger by stimulation of the afferent nerves of the stomach wall, that they are initiated by local automatic mechanisms, and that they are inhibited by various substances which stimulate the nerve endings in the gastric mucosa (gastric juice, acids, alcohol, &c.). Prof. Asher, of Berne, claimed to have demonstrated the presence in the vagus of secretory fibres to the kidneys, and Prof. Noyons, of Liège, showed curves which he believed indicated that there is an antagonism between the internal secretion of the pancreas and adrenalin. The demonstration by Prof. Magnus, of Utrecht, on the influence of the position of the head on the posture in decerebrate rigidity and in normal rabbits was very interesting. The effects are in part due to reflexes from the neck and partly to labyrinthine reflexes.

A novelty of great interest to those interested in painting was the demonstration by Mr. A. H. Munsell, of Boston. This was a quantitative classification of pigment colours based upon measurements by a daylight photometer, Maxwell discs, and the trained discrimination of the painter. The photometer uses the daylight adapted eye, and reads in terms of the Weber-Fechner law.

A somewhat surprising communication came from Prof. Hürthle, of Breslau, who has made a careful study of the variations in pressure and velocity in various arteries during the pulse wave in living animals, and in dead animals perfused by means of an "artificial heart." From these experiments the conclusion is drawn that the arteries are rhythmically contractile, and that their contraction aids the circulation of the blood. It would be interesting to see these experiments repeated with a dead animal perfused from a living heart prepared according to Starling's method.

Many interesting apparatus were shown; among these may be mentioned the now well-known apparatus of Prof. Krogh, of Copenhagen, for the investigation of various respiratory problems; that of Dr. Franz Müller, of Berlin, for the determination of the minute-volume output of the heart in man by a simple application of the nitrous oxide method; the "Kurvenkino" devised by Prof. Straub, of Freiburg, by means of which tracings made on smoked glass in the laboratory may be projected on a screen with realistic effect (apparatus made by Jaquet, of Basel); and the apparatus of Dr. Rohde, of Heidelberg, for the measurement of the oxygen usage of the frog's heart under various conditions of contraction. Dr. Laqueur also showed a projection method for exhibiting the movements of the intestines to a large audience.

The great event of the congress so far as communications are concerned was the closing lecture, which was given by Prof. Pawlow, of St. Petersburg, on "Die Erforschung der höheren Nerventätigkeit," in which he dealt with the subject of conditional reflexes, to which he has devoted the latter third of his active scientific career. Prof. Pawlow is of the opinion that psychology in its present condition can be of little service to the physiologist. The physiologist must remain a physiologist, and must investigate his problems by the recognised methods which have been so fruitful in other fields—he must study the brain as an integrated working organ, and must build up his knowledge independently of the psychologist. The study of reflex action as a purely physiological topic has already yielded valuable results on treatment by the methods of experimental physiology. It is rendered clear by the work of the Pawlow school that we must extend our ideas of reflex action and recognise that besides the elementary function of carrying out ready-formed reflexes, the nervous system has another equally important and fundamental function—that of the formation of new reflexes. It is a generally recognised property of living organisms to adapt themselves to their surroundings, or, in other words, to respond in suitable manner to what were previously indifferent agencies. So far, the reflexes which have been most studied by Pawlow have been those concerned with the secretion of saliva in dogs. Various stimuli can be given so as to affect different sense-organs in different cases, and at the same time the animal is fed, or acid introduced into its mouth; after a short period of such treatment a new reflex has been introduced, for now on application of the accompanying ("conditional") stimulus alone, without the introduction of the food or acid ("unconditional stimulus"), a reflex secretion of saliva occurs. Such reactions have all the characters of the true reflexes, and are equally simple in character, and not, as might seem at first sight, complicated processes grafted on to an unconditional reflex. The intricacy of the conditional reflex is due not to the complex nature of the neural processes involved in the reflex, but to the ease with which it can be inhibited; innumerable conditions in the nervous system itself and in the outer world modify it in this way, and thus investigation of the phenomena is not easy. In close relation to the formation of a conditional reflex is the function of the analysis of the sensations which reach the organism from the outer world, and from which some components are selected by the process of analysis; it is only these selected components which are really utilised in the construction of the new reflex. It seems, then, that by careful study of these reflexes we have the means for acquiring an accurate knowledge of the functional activity of the analysing mechanism. The chief problems which have been investigated are those concerned, firstly, with the origin of the conditional reflexes, and secondly with the mechanism of analysis of sensations. These reflexes can be formed in relation to strong as well as to indifferent stimuli; thus powerful electric stimuli applied to the skin, when the reflex has been trained, do not lead to movements of defence or aggression as is at first the case, but merely to the feeding reflexes of which the flow of saliva is the easiest to follow. This is to be explained as due to the formation of new nerve paths, determined by different excitability of the various nerve centres. Thus the stimulation of bone cannot be made to yield the conditional reflex, since the centres connected with painful stimulation of bone are more powerful than those connected with alimentation.

An important condition for the upbuilding of a conditional reflex is that the particular conditional stimulus used must precede, or accompany, not follow, the unconditional stimulus (food or acid). If it follows the unconditional stimulus, inhibitions are set up, and this inhibition has also been studied. It is also of great importance that the stimulus employed be strictly isolated from incidental ones; in some of the earlier investigations it appeared that the real conditional stimulus was given by the operator himself, by some peculiarity of odour or movements, and not at all by the stimulus which he believed he was employing. For this reason the animals are now always isolated in special rooms, which no person enters during the course of an experiment, all the conditions and observations being controlled from without by means of electrical or pneumatic arrangements.

With regard to the inhibitory processes to which the reflexes are so subject, there may be distinguished three kinds of inhibition. Firstly, we have the inhibition during sleep. Secondly, the inhibition by means of the arrival of other stimuli which have an inhibitory effect (external inhibition). Thirdly, there is a variety which is called "internal inhibition." This is developed as a result of special relations between the conditional and unconditional stimuli by means of which the particular reflex has been prepared. When, for instance, the conditional stimulus is not followed by the customary unconditional one for some time, it becomes converted into an inhibition. When in the developed reflex the conditional stimulus is not followed (or "confirmed") by the unconditional one, the type of inhibition is called "extinction"; when in working out the reflex the unconditional stimulus only follows some minutes after the conditional, the inhibition which intervenes is called "retardation." "Conditional inhibition" is seen when the conditional stimulus, when accompanied by an indifferent stimulus, is not followed by the unconditional stimulus; lastly, "differential inhibition" is seen in the fact that stimuli approaching closely to the conditional stimulus, and which at the commencement are effective, become eventually inactive. That all these phenomena are really due to inhibition can be shown by the fact that under appropriate conditions the inhibition may be removed, and the effect manifested ("Loshemmung").

The powers of discrimination of the analysors are greatly increased during the development of the reflex, and the conditional stimulus becomes more and more limited and specialised until finally it corresponds to a very small part of the analysing mechanism. Experiments in which definite parts of the cerebral hemispheres have been removed have taught that the cerebrum is the organ which is responsible for the upbuilding of these new reflexes. Want of space renders it impossible to give an account of these experiments on the results of partial extirpation of the cerebrum, since these were given in such brief outline in the lecture that further abstraction is not possible. It is to be hoped, however, that Prof. Pawlow will soon give to the world a book on the subject similar to his famous work on the "Work of the Digestive Glands," since practically all the abundant literature on this new subject is only to be obtained in the Russian language at the present time.

The next International Physiological Congress will be held in Paris in 1916, with Prof. Tigerstedt, of Helsingfors, as President.

C. Lovatt Evans.

THE DUAB OF TURKESTAN.[1]

In its opening sentence this book raises an important question, of the propriety of appropriating a word belonging to a language foreign to us and using it, in a sense equally foreign to

Fig. 1.—Mudspate-track opposite Veshab in the Zarafshan Valley. From "The Duab of Turkestan."

its native country, in order to express a concept at variance with its original sense. The word *doab*, signifying originally the confluence of two streams, and secondarily the tongue of land between them, has been introduced by Prof. W. M. Davis for a portion of a coastal plain lying between two rivers which never unite, but flow independently to the sea; in the form "duab" it is used by Mr. Rickmers for the country lying between two rivers, the Oxus and Jaxartes, which flow independently into the Sea of Aral, and includes not only the area of plain, which would come under Prof. Davis's use of the word *doab*, but the whole of the mountain region bounded on either side by the main streams of the two rivers.

[1] "The Duab of Turkestan: A Physiographic Sketch and Account of some Travels." By W. Rickmer Rickmers. Pp. xv+564+plates+maps. (Cambridge: University Press, 1913.) Price 30s. net.

For the purpose of a title there is comparatively little objection to this use of the word, but when Mr. Rickmers goes on to coin the adjective "duabic" for the type of scenery developed in this region, a protest must be entered against the needless introduction of a term that conveys no impression of the thing which it represents. The region dealt with presents the results of conditions which are widely spread, and repeated wherever mountains rise high enough, out of what would otherwise be a desert plain, to catch and condense rain from the upper layers of the atmosphere. In such a region the effects of erosion and deposition caused by running water are much more conspicuous than in a moister climate, for the simple reason that they are uncomplicated by the action of other agencies of denudation, with the exception of wind and rapid changes of temperature.

Something, also, must be said in protest against the extremes to which Mr. Rickmers carries the use of metaphor and illustration, too commonly adopted by geographical writers. The use of an illustration by analogy is often illuminating, and may serve to render the result of a complicated series of observations and deductions intelligible to those who have neither need nor leisure to follow the whole course of the research, but quite as often it may merely produce a misleading appearance of understanding where no true explanation is forthcoming, and it is especially dangerous when used, as Mr. Rickmers appears to use it, as a method of research. The description of a range of hills as a "squashed and warty reptile" may recall its appearance to the writer, but does not help the reader; and to talk of the "solid octopus of the Mustagh Pamirs sending out its long, spare tentacles towards the east, gripping the expanses of Tibet, Lop, and Mongolia," is likely to mislead the uninitiated.

Having said this, we must acknowledge the interest of the work as a description of a type of scenery, race, and civilisation absolutely different from anything which the dweller in western Europe or North America will meet with, and would especially commend the description of what the author terms the pamirian type of scenery, which characterises the mountains of central Asia, and his study of the features which distinguish it from the alpine type, met with in the mountains of Europe and western Asia. Something, too, must be said in praise not merely of the number and excellence of the illustrations, but, what is unfortunately more rare, of the judgment with which they have been selected to serve as real illustrations and elucidations of the text.

Fig. 2.—Turrets and Bastions of Conglomerate (Yakhsu). From "The Duab of Turkestan.

BRITISH ASSOCIATION BIRMINGHAM MEETING.

As anticipated, this year's meeting of the British Association has been the largest since 1904. In that year, Cambridge mustered 2789 members, and the Birmingham figure of 2635 does not fall far short of that.

Besides the amplitude of Birmingham's resources in the matter of public institutions, hotel accommodation, and private hospitality, the glorious weather which illumined the proceedings must be given its due share of credit for the success of the gathering. The somewhat unusual combination of the Presidency of the Association and the Principalship of the local University in one person seems, on this occasion, to have been attended with the happiest results. It certainly had a great effect in stimulating local interest, besides attracting a number of the foremost foreign exponents of the exact sciences. The ovation accorded to Madame Curie, more especially by her own sex, was as remarkable as the extraordinary popularity achieved by Prof. Lorentz, who succeeded in making even so formidable a subject as entropy attractive and entertaining to the generality of members.

The fact that the old Mason College, the Midland Institute, and the Technical College are within a stone's throw of each other accounts for the ease with which members could pass from one section to the other. The Geography Section, it is true, was inconvenienced by the noise of the traffic outside the Midland Institute, which is greatest in the morning, but the other sections were admirably housed. Section A had, on the whole, the best lecture theatre, although the applause in the Zoology Section overhead occasionally disconcerted (pleasantly, perhaps) the lecturing physicist below, who sometimes failed to locate the sound.

The arrangements in the reception room met with high commendation on all sides. The spacious Town Hall was an ideal place for the purpose. The ground floor was fitted with luxurious carpets and easy chairs, and a specially built staircase ascended to the gallery, which was laid out in some forty writing compartments. Even at times of the greatest activity, it was reasonably easy to find one's way about, and the local secretaries deserve much credit for the completeness and adequacy of the accommodation afforded.

A still greater triumph of organisation was the Lord Mayor's reception at the Council House, where 3500 visitors had to be marshalled and entertained. Large as was the assemblage, it was quickly distributed over a large space, the new Art Gallery and the Natural History Museum being thrown open for the occasion, so that the sense of crowding conveyed by the hour's procession into the reception chamber was quickly dispelled. The visitors had an agreeable choice between band music; exhibits of British birds, nests, and eggs; dancing; and Dr. Collisson's musical and humorous entertainment in the Council Chamber.

Friday's afternoon reception at Messrs. Cadbury's factory at Bournville gave visitors an interesting though short glimpse of the well-known model village and its various institutions. The spacious recreation ground was the scene of a pretty masque and some maypole dances by the village children which were set off very attractively by the brilliant sunshine, though provision had been made for the event of rain by the erection of three spacious marquees capable of accommodating the whole of the visitors, numbering, as they did, several thousand. The guests were taken back to Birmingham by special trains running by two routes, so that both platforms could be utilised—a fortunate detail which avoided much inconvenience.

Saturday's excursions were a welcome change, both to the visitors who had conscientiously spent their time every morning at the sections, and the secretarial officials, who gained some time to make up arrears of work. It was notable that the foreign visitors preferred the roads that led to Stratford-on-Avon, though Malvern, Kenilworth, Worcester, Coventry, Lichfield, and the Forest of Arden put forth their strongest magnetism, aided by the hospitable efforts of their resident aristocracy. The geological excursions to Nuneaton and Hartshill, the Lickey and Clent Hills, the Wrekin, and the Lutley Valley, the botanical excursion to Sutton, and the excursion to the Burbage experimental farm were of absorbing interest to those specially concerned.

The ecclesiastical services on Sunday were well attended, and the various preachers took pains to emphasise the points in which they agreed with the declarations of prominent speakers from Association chairs. They seemed to find these points unusually numerous. The afternoon saw a large social gathering of physicists and mathematicians at "Mariemont," Sir Oliver Lodge's residence, at which Friday's radiation discussion was informally continued, though not by any means concluded.

The entertainments provided by the local committee for the Monday evening gave members a choice of three. There was St. John Hankin's "Return of the Prodigal" at the Repertory Theatre, Glück's "Orpheus" at the Prince of Wales's Theatre, and a special series of animated pictures dealing with scientific and historical subjects at the Picture House, New Street. The opera was patronised by a brilliant gathering which filled the theatre to overflowing, and Herr Denhof's company gave a new life to the eighteenth century work by symbolic dances and movements which brought out all the tenderness and pathos of the music and the otherwise rather formal acting.

Of the scientific proceedings of the meeting it is difficult to speak with discrimination until a few days have elapsed after its conclusion. The twelve main sections each had their devoted band of special followers, and each had some special occasion on which its proceedings commanded a larger general interest. Thus it was with the radiation discussion in Section A, the fuel and radioactivity discussions in Section B, the joint discussions of Sections D, I, and K on the synthesis of organic matter by inorganic colloids in the presence of sunlight (in which, by the way, Prof. Moore did not by any means succeed in carrying the majority of his colleagues with him, though his exposition was of masterly clearness); the waterways debate in Section F (a matter of vital interest to Birmingham); the anæsthetics report in Section I; and the modern university discussion in Section L.

The great popularity of these discussions has again emphasised the fact that the average member does not come to hear isolated papers of miscellaneous interest. It more than ever throws upon the recorder of each section the responsibility of grouping its papers according to their natural affinities. This seems to be the only chance which the isolated paper has of surviving at the British Association meetings. The numerous facilities now available for publication render it less and less necessary to look to the British Association for a platform from which to announce discoveries, and the practice, so common in the earlier days, is now largely in abeyance. But for bringing like-minded people together to discuss matters of scientific interest, for gauging the trend of opinion on matters of controversy, and for focussing public opinion on matters of importance to the commonweal, the British Association is pre-eminently useful, and the Birmingham gathering has shown that it is not likely to abandon that function for many years to come.

E. E. F.

At an Honorary Degree Congregation of the University of Birmingham, on Thursday, September 11, some distinguished foreigners received honorary degrees, and the following speeches were made by the Principal in presenting them to the Vice-Chancellor:—

Dr. Arrhenius.

Director of the Nobel Institute for Physics and Chemistry, at Stockholm, fellow of the Swedish Academy of Sciences, and foreign member of our own Royal Society. The courageous way in which Dr. Arrhenius applied the theory of electrolytic dissociation to a quantitative study of chemical reactions has profoundly modified the trend of chemical science during the past thirty years, enlarging the scope of chemical investigation, harmonising previously disconnected facts, and bringing an ever-increasing number of chemical phenomena within the range of quantitative and mathematical treatment. He is thus one of the most prominent of the founders of modern physical chemistry, the principles of which he has even applied, with singular success, to some of the most subtle phenomena of organic life. Recently his writings on cosmogony have aroused wide interest; terrestrial electricity and the aurora have yielded to him some of their secrets; and his speculations on worlds in the making are more than interesting and suggestive. A man of genius, and one of the founders of physical chemistry, I present for the honorary degree of doctor of laws, Svante August Arrhenius.

Madame Curie.

The discoverer of radium, director of the Physical Laboratory at the Sorbonne, and member of the Imperial Academy of Sciences at Cracow. All the world knows how Madame Curie (coming from Warsaw as Marie Sklodowska to work in Paris), inspired by the spontaneous radio-activity newly discovered by Becquerel, began in 1896 a metrical examination of the radio-activity of minerals of all kinds; and how, when a uranium residue showed a value larger than could have been expected from its uranium content, she, with exemplary skill and perseverance, worked down some tons of this material (given her by the Austrian Government on the instigation of Prof. Suess), chemically dividing it and retaining always the more radioactive portion, until she obtained evidence first of a new element which she christened polonium, in memory of her own country, and then after months of labour succeeded in isolating a few grains of the other and more permanent substance now so famous—a substance which not only exhibits physical energy in a new form, but is likely to be of service to suffering humanity. Of the metallic base of this substance she determined the atomic weight, finding a place for it in Mendeléeff's series; and with the aid of her husband, whose lamentable death was so great a blow to science, she proceeded to discover many of its singular properties, some of them so extraordinary as to rivet the attention of the world. Subsequent workers engaged in the determination of numbers belonging to either of her special elements, radium and polonium, have sought her advice, and it has proved of the utmost value. I have now the honour of presenting for our honorary degree the greatest woman of science of all time, Marie Sklodowska Curie.

Prof. Dr. Keibel.

The professor of anatomy in the University of Freiburg is the leading authority on the development of man and the embryology of vertebrates. He originated the international standards used in estimating embryological data, and through his classical work on comparative development he has reformed anatomical teaching by the infusion of developmental ideas. His important contributions to anatomical knowledge and method are widely known and highly esteemed, but nowhere more heartily and cordially than in the anatomical department of this University. Held in affectionate esteem by his colleagues, and directing one of the largest schools of anatomy in Germany, this eminent embryologist has been invited to receive our honorary degree, and I present to you Franz Karl Julius Keibel.

Prof. H. A. Lorentz.

To the great school of mathematical physicists of the last and present centuries we in England have proudly contributed even more than our share; but we recognise in the professor of physics in the University of Leyden a contemporary worker worthy to rank with our greatest. Prof. Lorentz has extended the work of Clerk Maxwell into the recently explored region of electrons, and has developed in the molecular direction the Maxwellian theory of electrodynamics. He is a chief authority on the behaviour of material bodies moving through the æther of space, and he has adopted and reduced to order many of the progeny resulting from the fertile marriage of electricity and light. A specially interesting magneto-optic phenomenon, experimentally discovered by his countryman, Zeeman, of Amsterdam, received at his hands its brilliant and satisfying interpretation; an interpretation clinched by predictions of what, on the electric theory of radiation, ought additionally to be observed—predictions which were speedily verified. The Zeeman phenomenon thus interpreted not only gives information as to the intimate structure of various elemental atoms, but, in the hands of the great American astronomers, has shown that sun-spots are electric cyclones of high magnetic power, and is likely further to contribute to our knowledge of solar and stellar constitution. As a great authority on electron theory, and one whose name will for ever be associated with the now nascent electrical theory of matter, I present to you the distinguished mathematical physicist, Hendrik Antoon Lorentz.

Prof. R. W. Wood.

The professor of experimental physics in the Johns Hopkins University of Baltimore is a prolific experimentalist, and one to whose researches in physical optics modern science is greatly indebted. By ingenious use of little-known properties of light, he has explored the structure of molecules, applying the principle of resonance to determine their natural electronic period of vibration. He has, in fact, discovered a new type of spectra in the fluorescent resonance of metallic vapours. What more he has done, in connection with the anomalous absorption of sodium vapour, with specially designed diffraction gratings, and with the application of monochromatic photography to the geology of the moon, it were long to tell; among other things, he anticipated and realised the attainment of regular reflection from a sufficiently dense absorbing vapour; while to the public in America he is known as the inventor of a practical method of thawing frozen pipes by an electric current. The idea of a gigantic telescope in the form of a sunk well, with a revolving pool of mercury at its base to constitute a truly parabolic mirror, may not be a new one, but Prof. Wood has taken it out of the region of the chimerical and shown that it is possible, even if not practically useful. We in this country have reason to envy the splendid resources which the munificence of citizens in America, and of Governments elsewhere, places at the disposal of scientific explorers, and we honour and admire the use which is being made of those resources in every branch of science. As one of the most brilliant experimental physicists of the world, I present for our honorary degree Robert Williams Wood.

Synopsis of grants of money appropriated for scientific purposes by the general committee at the Birmingham meeting September, 1913:—

Section A—Mathematical and Physical Science.

Prof. H. H. Turner, seismological observations ...	£60 0 0	
Dr. W. N. Shaw, upper atmosphere	25 0 0	
Sir W. Ramsay, constants and numerical data	40 0 0	
Prof. M. J. M. Hill, calculation of mathematical tables	20 0 0	
Lieut.-Col. A. Cunningham, copies of the "Binary Canon" for presentation ...	5 0 0	
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Prof. W. J. Pope, correlation of crystalline form with molecular structure ...	25 0 0	
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Section C—Geology.

R. H. Tiddeman, erratic blocks	5 0 0	
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Dr. A. Strahan, Ramsay Island, Pembroke	10 0 0	
Prof. Grenville Cole, Old Red Sandstone of Kiltorcan	10 0 0	
G. Barrow, trias of western midlands	10 0 0	
Prof. W. W. Watts, sections in Lower Palæozoic rocks	15 0 0	
		£55 0 0

Section D—Zoology.

Dr. A. E. Shipley, Belmullet Whaling Station	20 0 0	
Dr. Chalmers Mitchell, nomenclator animalium ...	50 0 0	
S. F. Harmer, Antarctic whaling industry	90 0 0	
		£160 0 0

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Prof. J. L. Myres, maps for school and university use...	40 0 0	
Prof. H. N. Dickson, tidal currents in Moray and adjacent firths	40 0 0	
		£80 0 0

Section G—Engineering.

Sir W. H. Preece, gaseous explosions	50 0 0	
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		£100 0 0

Section H—Anthropology.

Dr. R. Munro, Glastonbury Lake Village	20 0 0	
Sir C. H. Read, age of stone circles	20 0 0	
Dr. R. Munro, artificial islands in Highland lochs	5 0 0	
Prof. G. Elliot Smith, physical character of ancient Egyptians	34 16 6	
Prof. J. L. Myres, anthropometric investigations in Cyprus	50 0 0	
Prof. W. Ridgeway, Roman sites in Britain	20 0 0	
Dr. R. R. Marett, Palæolithic site in Jersey	50 0 0	
		£199 16 6

Section I—Physiology.

Prof. E. A. Schäfer, the ductless glands	35 0 0	
Prof. A. D. Waller, anæsthetics	20 0 0	
Prof. J. S. Macdonald, calorimetric observations ...	40 0 0	
Prof. C. S. Sherrington, mammalian heart	30 0 0	
		£125 0 0

Section K—Botany.

Prof. F. J. Oliver, structure of fossil plants	15 0 0	
Prof. A. C. Seward, Jurassic flora of Yorkshire	5 0 0	
Prof. F. Keeble, flora of peat of Kennet Valley	15 0 0	
A. G. Tansley, vegetation of Ditcham Park	20 0 0	
Prof. F. F. Blackman, physiology of heredity	30 0 0	
Prof. F. O. Bower, renting of Cinchona Botanic Station in Jamaica	25 0 0	
Prof. W. Bateson, breeding experiments with Œnotheras	20 0 0	
		£130 0 0

Section L—Education.

Prof. J. J. Findlay, mental and physical factors ...	30	0	0			
Dr. G. A. Auden, influence of school books on eyesight	15	15	3			
Sir H. Miers, Number, &c., of scholarships, &c., held by university students ...	5	0	0			
Myers, Dr. C. S., binocular combination of kinematograph pictures	10	0	0			
Prof. J. A. Green, character and maintenance of museums	10	0	0			
				£70	15	3

Corresponding Societies Committee.

W. Whitaker, for preparation of report	25	0	0			
				£25	0	0
Total				£1215	11	9

SECTION A.

MATHEMATICS AND PHYSICS.

Opening Address by H. F. Baker, Sc.D., F.R.S., President of the Section.

The Place of Pure Mathematics.

It is not a very usual thing for the opening address of this section to be entrusted to one whose main energies have been devoted to what is called pure mathematics; but I value the opportunity in order to try to explain what, as I conceive it, the justification of the pure mathematician is. You will understand that in saying this I am putting myself in a position which belongs to me as little by vocation as by achievement, since it was my duty through many years to give instruction in all the subjects usually regarded as mathematical physics, and it is still my duty to be concerned with students in these subjects. But my experience is that the pure mathematician is apt to be regarded by his friends as a trifler and a visionary, and the consciousness of this becomes in time a paralysing dead-weight. I think that view is founded on want of knowledge.

Of course, it must be admitted that the mathematician, as such, has no part in those public endeavours that arise from the position of our Empire in the world, nor in the efforts that must constantly be made for social adjustment at home. I wish to make this obvious remark. For surely the scientific man must give his time and his work in the faith of at least an intellectual harmony in things; and he must wish to know what to think of all that seems out of gear in the working of human relations. His own cup of contemplation is often golden; he marks that around him there is fierce fighting for cups that are earthen, and largely broken; and many there are that go thirsting. And, again, the mathematician is as sensitive as others to the marvel of each recurring springtime, when, year by year, our common mother seems to call us so loudly to consider how wonderful she is, and how dependent we are, and he is as curious as to the mysteries of the development of living things. He can draw inspiration for his own work, as he views the spectacle of a starry night, and sees

> How the floor of heaven
> Is thick inlaid with patines of bright gold.
> Each orb, the smallest, in his motion, sings,

but the song, once so full of dread, how much it owes to the highest refinements of his craft, from at least the time of the Greek devotion to the theory of conic sections; how much, that is, to the harmony that is in the human soul. Yet the mathematician bears to the natural observer something of the relation which the laboratory botanist has come to bear to the field naturalist. Moreover, he is shut off from inquiries which stir the public imagination; when he looks back the ages over the history of his own subject, the confidence of his friends who study heredity and teach eugenics arouses odd feelings in his mind; if he feels the fascination which comes of the importance of such inquiries, he is also prepared to hear that the subtlety of Nature grows with our knowledge of her. Doubtless, too, he wishes he had some participation in the discovery of the laws of wireless telegraphy, or had something to say in regard to the improvement of internal-combustion engines or the stability of aëroplanes; it is little compensation to remember, though the mathematical physicist is his most tormenting critic, what those of his friends who have the physical instinct used to say on the probable development of these things, however well he may recall it.

But it is not logical to believe that they who are called visionary because of their devotion to creatures of the imagination can be unmoved by these things. Nor is it at all just to assume that they are less conscious than others of the practical importance of them, or less anxious that they should be vigorously prosecuted.

Why is it, then, that their systematic study is given to other things, and not of necessity, and in the first instance, to the theory of any of these concrete phenomena? This is the question I try to answer. I can only give my own impression, and doubtless the validity of an answer varies as the accumulation of data, made by experimenters and observers, which remains unutilised at any time.

The reason, then, is very much the same as that which may lead a man to abstain from piecemeal indiscriminate charity in order to devote his attention and money to some well-thought-out scheme of reform which seems to have promise of real amelioration. One turns away from details and examples, because one thinks that there is promise of fundamental improvement of methods and principles. This is the *argumentum ad hominem.* But there is more than that. The improvement of general principles is arduous, and if undertaken only with a view to results may be ill-timed and disappointing. But as soon as we consciously give ourselves to the study of universal methods for their own sake another phenomenon appears. The mind responds, the whole outlook is enlarged, infinite possibilities of intellectual comprehension, of mastery of the relations of things, hitherto unsuspected, begin to appear on the mental horizon. I am well enough aware of the retort to which such a statement is open. But, I say, interpret the fact as you will, our intellectual pleasure in life cometh not by might nor by power—arises, that is, most commonly, not of set purpose—but lies at the mercy of the response which the mind may make to the opportunities of its experience. When the response proves to be of permanent interest—and for how many centuries have mathematical questions been a fascination?—we do well to regard it. Let us compare another case which is, I think, essentially the same. It may be that early forms of what now is specifically called art arose with a view to applications; I do not know. But no one will deny that art, when once it has been conceived by us, is a worthy object of pursuit; we know by a long trial that we do wisely to yield ourselves to a love of beautiful things, and to the joy of making them. Well, pure mathematics, as such, *is* an art, a creative art. If its past triumphs of achievement fill us with wonder, its future scope for invention is exhaustless and open to all. It is also a science. For the mind of man is one; to scale the peaks it spreads before the explorer is to open ever new prospects of possibility for the formulation of laws of nature. It resources have been tested by the experience of generations; to-day it lives and thrives and expands and wins the life-service of more workers than ever before.

This, at least, is what I wanted to say, and I have said it with the greatest brevity I could command. But may I dare attempt to carry you further? If this seems fanciful, what will you say to the setting in which I would wish to place this point of view? And yet I feel bound to try to indicate something more, which may be of wider appeal. I said a word at starting as to the relations of science to those many to whom the message of our advanced civilisation is the necessity, above all things, of getting bread. Leaving this aside, I would make another reference. In our time old outlooks have very greatly changed; old hopes, disregarded perhaps because undoubted, have very largely lost their sanction, and given place to earnest questionings. Can anyone who watches doubt that the courage to live is in some danger of being swallowed up in the anxiety to acquire? May it not be, then, that it is good for us to realise, and to confess, that the pursuit of things that are beautiful, and the achievement of intellectual things that bring the joy of overcoming, is at least as demonstrably justifiable as the many other things that fill the lives of men? May it not be that a wider recognition of this would be of some general advantage at present? Is it not even possible that to bear witness to this is one of the uses of the scientific spirit? Moreover, though the pursuit of truth be a noble aim, is it so new a profession; are we so sure that the ardour to set down all the facts without extenuation is, unassisted, so continuing a purpose? May science itself not be wise to confess to what is its own sustaining force?

Such, ladies and gentlemen, in crude, imperfect phrase, is the *apologia*. If it does not differ much from that which workers in other ways would make, it does, at least, try to represent truly one point of view, and it seems to me specially applicable to the case of pure mathematics. But you may ask: What, then, is this subject? What can it be about if it is not primarily directed to the discussion of the laws of natural phenomena? What kind of things are they that can occupy alone the thoughts of a lifetime? I propose now to attempt to answer this, most inadequately, by a bare recital of some of the broader issues of present interest—though this has difficulties, because the nineteenth century was of unexampled fertility in results and suggestions, and I must be as little technical as possible.

Precision of Definitions.

First, in regard to two matters which illustrate how we are forced by physical problems into abstract inquiries. It is a constantly recurring need of science to reconsider the exact implication of the terms employed; and as numbers and functions are inevitable in all measurement, the precise meaning of number, of continuity, of infinity, of limit, and so on, are fundamental questions; those who will receive the evidence can easily convince themselves that these notions have many pitfalls. Such an imperishable monument as Euclid's theory of ratio is a familiar sign that this has always been felt. The last century has witnessed a vigorous inquiry into these matters, and many of the results brought forward appear to be new; nor is the interest of the matter by any means exhausted. I may cite, as intelligible to all, such a fact as the construction of a function which is continuous at all points of a range, yet possesses no definite differential coefficient at any point. Are we sure that human nature is the only continuous variable in the concrete world, assuming it be continuous, which can possess such a vacillating character? Or I may refer to the more elementary fact that all the rational fractions, infinite in number, which lie in any given range, can be enclosed in intervals the aggregate length of which is arbitrarily small. Thus we could take out of our life all the moments at which we can say that our age is a certain number of years, and days, and fractions of a day, and still have appreciably as long to live; this would be true, however often, to whatever exactness, we named our age, provided we were quick enough in naming it. Though the recurrence of these inquiries is part of a wider consideration of functions of complex variables, it has been associated also with the theory of those series which Fourier used so boldly, and so wickedly, for the conduction of heat. Like all discoverers, he took much for granted. Precisely how much is the problem. This problem has led to the precision of what is meant by a function of real variables, to the question of the uniform convergence of an infinite series, as you may see in early papers of Stokes, to new formulation of the conditions of integration and of the properties of multiple integrals, and so on. And it remains still incompletely solved.

Calculus of Variations.

Another case in which the suggestions of physics have caused grave disquiet to the mathematicians is the problem of the variation of a definite integral. No one is likely to underrate the grandeur of the aim of those who would deduce the whole physical history of the world from the single principle of least action. Everyone must be interested in the theorem that a potential function, with a given value at the boundary of a volume, is such as to render a certain integral, representing, say, the energy, a minimum. But in that proportion one desires to be sure that the logical processes employed are free from objection. And, alas! to deal only with one of the earliest problems of the subject, though the finally sufficient conditions for a minimum of a simple integral seemed settled long ago, and could be applied, for example, to Newton's celebrated problem of the solid of least resistance, it has since been shown to be a general fact that such a problem cannot have any definite solution at all. And, although the principle of Thomson and Dirichlet, which relates to the potential problem referred to, was expounded by Gauss, and accepted by Riemann, and remains to-day in our standard treatise on natural philosophy, there can be no doubt that, in the form in which it was originally stated, it proves just nothing. Thus a new investigation has been necessary into the foundations of the principle. There is another problem, closely connected with this subject, to which I would allude: the stability of the solar system. For those who can make pronouncements in regard to this I have a feeling of envy; for their methods, as yet, I have a quite other feeling. The interest of this problem alone is sufficient to justify the craving of the pure mathematician for powerful methods and unexceptionable rigour.

Non-Euclidean Geometry.

But I turn to another matter. It is an old view, I suppose, that geometry deals with facts about which there can be no two opinions. You are familiar with the axiom that, given a straight line and a point, one and only one straight line can be drawn through the point parallel to the given straight line. According to the old view the natural man would say that this is either true or false. And, indeed, many and long were the attempts made to justify it. At length there came a step which to many probably will still seem unintelligible. A system of geometry was built up in which it is assumed that, given a straight line and a point, an infinite number of straight lines can be drawn through the point, in the plane of the given line, *no one* of which meets the given line. Can there, then, one asks at first, be two systems of geometry, both of which are true, though they differ in such an important particular? Almost as soon believe that there can be two systems of laws of nature, essentially differing in character, both reducing the phenomena we observe to order and system —a monstrous heresy, of course! I will only say that, after a century of discussion we are quite sure that many systems of geometry are possible, and true; though not all may be expedient. And if you reply that a geometry is useful for life only in proportion as it fits the properties of concrete things, I will answer, first, are the heavens not then concrete? And have we as yet any geometry that enables us to form a consistent logical idea of furthermost space? And, secondly, that the justification of such speculations is the interest they evoke, and that the investigations already undertaken have yielded results of the most surprising interest.

The Theory of Groups.

To-day we characterise a geometry by the help of another general notion, also, for the most part, elaborated in the last hundred years, by means of its group. A group is a set of operations which is closed, in the sense that the performance of any two of these operations in succession is equivalent to another operation of the set, just as the result of two successive movements of a rigid body can be achieved by a single movement. One of the earliest conscious applications of the notion was in the problem ot solving algebraic equations by means of equations of lower order. An equation of the fourth order can be solved by means of a cubic equation, because there exists a rational function of the four roots which takes only three values when the roots are exchanged in all possible ways. Following out this suggestion for an equation of any order, we are led to consider, taking any particular rational function of its roots, what is the group of interchanges among them which leaves this function unaltered in value. This group characterises the function, all other rational functions unaltered by the same group of interchanges being expressible rationally in terms of this function. On these lines a complete theory of equations which are soluble algebraically can be given. Anyone who wishes to form some idea of the richness of the landscape offered by pure mathematics might do worse than make himself acquainted with this comparatively small district of it. But the theory of groups has other applications. It may be interesting to refer to the circumstance that the group of interchanges among four quantities which leave unaltered the product of their six differences is exactly similar to the group of rotations of a regular tetrahedron the centre of which is fixed, when its corners are interchanged among themselves. Then I mention the historical fact that the problem of ascertaining when that well-known linear differential equation called the hypergeometric equation has all its solutions expressible in finite terms as algebraic functions, was first solved in connection with a group of similar kind. For any linear differential equation it is of primary importance to consider the group of interchanges of its solutions when the independent variable, starting from an arbitrary point, makes all possible excursions, returning to its initial value. And it is in connection with this consideration that one justification arises for the view that the equation can be solved by expressing both the independent and dependent variables as single-valued functions of another variable. There is, however, a theory of groups different from those so far referred to, in which the variables can change continuously; this alone is most extensive, as may be judged from one of its lesser applications, the familiar theory of the invariants of quantics. Moreover, perhaps the most masterly of the analytical discussions of the theory of geometry has been carried through as a particular application of the theory of such groups.

The Theory of Algebraic Functions.

If the theory of groups illustrates how a unifying plan works in mathematics beneath bewildering detail, the next matter I refer to well shows what a wealth, what a grandeur, of thought may spring from what seem slight beginnings. Our ordinary integral calculus is well-nigh powerless when the result of integration is not expressible by algebraic or logarithmic functions. The attempt to extend the possibilities of integration to the case when the function to be integrated involves the square root of a polynomial of the fourth order, led first, after many efforts, among which Legendre's devotion of forty years was part, to the theory of doubly-periodic functions. To-day this is much simpler than ordinary trigonometry, and, even apart from its applications, it is quite incredible that it should ever again pass from being among the treasures of civilised man. Then, at first in uncouth form, but now clothed with delicate beauty, came the theory of general algebraical integrals, of which the influence is spread far and wide; and with it all that is systematic in the theory of plane curves, and all that is associated with the conception of a Riemann surface. After this came the theory of multiple-periodic functions of any number of variables, which, though still very far indeed from being complete, has, I have always felt, a majesty of conception which is unique. Quite recently the ideas evolved in the previous history have prompted a vast general theory of the classification of algebraical surfaces according to their essential properties, which is opening endless new vistas of thought.

Theory of Functions of Complex Variables: Differential Equations.

But the theory has also been prolific in general principles for functions of complex variables. Of greater theories, the problem of automorphic functions alone is a vast continent still largely undeveloped, and there is the incidental problem of the possibilities of geometry of position in any number of dimensions, so important in so many ways. But, in fact, a large proportion of the more familiar general principles, taught to-day as theory of functions, have been elaborated under the stimulus of the foregoing theory. Besides this, however, all that precision of logical statement of which I spoke at the beginning is of paramount necessity here. What exactly is meant by a curve of integration, what character can the limiting points of a region of existence of a function possess, how even best to define a function of a complex variable, these are but some obvious cases of difficulties which are very real and pressing to-day. And then there are the problems of the theory of differential equations. About these I am at a loss what to say. We give a name to the subject, as if it were one subject, and I deal with it in the fewest words. But our whole physical outlook is based on the belief that the problems of nature are expressible by differential equations; and our knowledge of even the possibilities of the solutions of differential equations consists largely, save for some special types, of that kind of ignorance which, in the nature of the case, can form no idea of its own extent. There are subjects the whole content of which is an excuse for a desired solution of a differential equation; there are infinitely laborious methods of arithmetical computation held in high repute of which the same must be said. And yet I stand here to-day to plead with you for tolerance of those who feel that the prosecution of the theoretic studies, which alone can alter this, is a justifiable aim in life! Our hope and belief is that over this vast domain of differential equations the theory of functions shall one day rule, as already it largely does, for example, over linear differential equations.

Theory of Numbers.

In concluding this table of contents, I would also refer, with becoming brevity, to the modern developments of theory of numbers. Wonderful is the fascination and the difficulty of these familiar objects of thought—ordinary numbers. We know how the great Gauss, whose lynx eye was laboriously turned upon all the physical science of his time, has left it on record that in order to settle the law of a plus or minus sign in one of the formulæ of his theory of numbers he took up the pen every week for four years. In these islands perhaps our imperial necessities forbid the hope of much development of such a theoretical subject. But in the land of Kummer and Gauss and Dirichlet the subject to-day claims the allegiance of many eager minds. And we can reflect that one of the latest triumphs has been with a problem known by the name of our English senior wrangler, Waring—the problem of the representation of a number by sums of powers.

Ladies and gentlemen, I have touched only a few of the matters with which pure mathematics is concerned. Each of those I have named is large enough for one man's thought; but they are interwoven and interlaced in indissoluble fashion and form one mighty whole, so that to be ignorant of one is to be weaker in all. I am not concerned to depreciate other pursuits, which seem at first sight more practical; I wish only, indeed, as we all do, it were possible for one man to cover the whole field of scientific research; and I vigorously resent the suggestion that those who follow these studies are less careful than others of the urgent needs of our national life. But pure mathematics is not the rival, even less is it the handmaid, of other branches of science. Properly pursued, it is the essence and soul of them all. It is not for them; they are for it; and its results are for all time. No man who has felt its fascination can be content to be ignorant of any manifestation of regularity and law, or can fail to be stirred by all the need of adjustment of our actual world.

And if life is short, if the greatest magician, joining with the practical man, reminds us that, like this vision,

> The cloud-capp'd towers, the gorgeous palaces,
> The solemn temples, the great globe itself,
> Yea, all which it inherit, shall dissolve
> And . . . leave not a rack behind,

we must still believe that it is best for us to try to reach the brightest light. And all here must believe it; for else—no fact is more firmly established—we shall not study science to any purpose.

But that is not all I want to say, or at least to indicate. I have dealt so far only with proximate motives; to me it seems demonstrable that a physical science that is conscientious requires the cultivation of pure mathematics; and the most mundane of reasons seem to me to prompt the recognition of the æsthetic outlook as a practical necessity, not merely a luxury, in a successful society. Nor do I want to take a transcendental ground. Every schoolboy, I suppose, knows the story of the child born, so small, if I remember aright, that he could be put into a quart pot, in a farmhouse on the borders of Lincolnshire—it was the merest everyday chance. By the most incalculable of luck his brain-stuff was so arranged, his parts so proportionately tempered, that he became Newton, and taught us the laws of the planets. It was the blindest concurrence of physical circumstances; and so is all our life. Matter in certain relations to itself, working by laws we can examine in the chemical laboratory, produces all these effects, produces even that state of brain which accompanies the desire to speak of the wonder of it all. And the same laws will inevitably hurl all into confusion and darkness again; and where will all our joys and fears, and all our scientific satisfaction, be then?

As students of science, we have no right to shrink from this point of view; we are pledged to set aside prepossession and dogma, and examine what seems possible, wherever it may lead. Even life itself may be mechanical, even the greatest of all things, even personality, may some day be resoluble into the properties of dead matter, whatever that is. We can all see that its coherence rises and falls with illness and health, with age and physical conditions. Nor, as it seems to me, can anything but confusion of thought arise from attempts to people our material world with those who have ceased to be material.

An argument could perhaps be based on the divergence, as the mathematician would say, of our comprehension of the properties of matter. For though we seem able to summarise our past experiences with ever-increasing approximation by means of fixed laws, our consciousness of ignorance of the future is only increased thereby. Do we feel more, or *less*, competent to grasp the future possibilities of things, when we can send a wireless message 4000 miles, from Hanover to New Jersey?

Our life is begirt with wonder, and with terror. Reduce it by all means to ruthless mechanism, *if you can;* it will be a great achievement. But it can make no sort of difference to the fact that the things for which we live are spiritual. The rose is no less sweet because its growth is conditioned by the food we supply to its roots. It is an obvious fact, and I ought to apologise for remarking it, were it not that so much of our popular science is understood by the hasty to imply an opposite conclusion. If a chemical analysis of the constituents of sea-water could take away from the glory of a mighty wave breaking in the sunlight, it would still be true that it was the mind of the chemist which delighted in finding the analysis. Whatever be its history, whatever its physical correlations, it is an undeniable fact that the mind of man has been evolved; I believe that is the scientific word. You may speak of a continuous upholding of our material framework from without; you may ascribe fixed qualities to something you call matter; or you may refuse to be drawn into any statement. But anyway, the fact remains that the precious things of life are those we call the treasures of the mind. Dogmas and philosophies, it would seem, rise and fall. But gradually accumulating throughout the ages, from the earliest dawn of history, there is a body of doctrine, a reasoned insight into the relations of exact ideas, painfully won and often tested. And this remains the main heritage of man; his little beacon of light amidst the solitudes and darknesses of infinite space; or, if you prefer, like the shout of children at play together in the cultivated valleys, which continues from generation to generation.

Yes, and continues for ever! A universe which has the potentiality of becoming thus conscious of itself is not without something of which that which we call memory is but an image. Somewhere, somehow, in ways we dream not of, when you and I have merged again into the illimitable whole, when all that is material has ceased, the faculty in which we now have some share, shall surely endure; the conceptions we now dimly struggle to grasp, the joy we have in the effort, these are but part of a greater whole. Some may fear, and some may hope, that they and theirs shall not endure for ever. But he must have studied nature in vain who does not see that our spiritual activities are inherent in the mighty process of which we are part; who can doubt of their persistence.

And, on the intellectual side, of all that is best ascertained, and surest, and most definite, of these; of all that is oldest and most universal; of all that is most fundamental and far-reaching, of these activities, pure mathematics is the symbol and the sum.

SECTION B.

CHEMISTRY.

Opening Address by Prof. W. P. Wynne, D.Sc., F.R.S., President of the Section.

When the present position of education in Birmingham is considered, the transformation effected since the 'seventies is little short of marvellous. Five-and-thirty years ago, when I became an evening student, classes conducted by the Midland Institute met the demand for arts and science subjects; now a University—venerable in comparison with all civic universities save the Victoria University of Manchester—exists to provide instruction in every branch of learning. The spacious building in which we meet—already too small for the demands made on it—is the lineal descendant of that part of the Midland Institute which formerly was used for evening class instruction in science, organised in connection with the science and art department, and financed largely by the system of payment on results; this large lecture theatre replaces the small and inconvenient class-room in which the teaching of chemistry and physics under Mr. Woodward was carried on. Payment on results is obsolete, and the "May" examinations on which it was based have almost disappeared, assessment by inspection now replacing both; nevertheless, it is more than doubtful whether any other system—in the circumstances of the time—could have spread so widely a knowledge of science among the people, or prepared the way for the Technical Instruction Act, and that appreciation of the value of scientific training for industrial pursuits, which is exemplified by the provision through municipal agencies of technical schools in the industrial centres of this country. I sometimes think the Science and Art Department, and those great men, Sir John Donnelly and Prof. Huxley, who did much to shape its attitude towards science instruction in evening classes and in the science schools at South Kensington,[1] have received something less than their share of credit for pioneering work which finds its fruition in well-equipped institutions like this, and in the enhanced position which science holds to-day in the estimation of our countrymen. In those far-off times, before the foundation-stone of Mason College was laid, such evening classes in Birmingham provided the only means by which instruction in science, or scholarships to South Kensington, could be obtained. It is not unfitting, therefore, that I—a product of the system—should acknowledge here the obligation under which I stand both to the Midland Institute and to the Science and Art Department for providing the ladder by which I have risen, however undeservedly, to the honourable position of president of this section.

The historian of our times will not fail to note some of the consequences which have followed the application of science to industry, possibly also some of the educational results which have followed the development of science teaching in schools of all grades. Except from one point of view these need not concern us now as they fall, the one in so far as chemistry is concerned, into the province of the Society of Chemical Industry, the other mainly within the purview of Section L. This bringing of chemistry to the people has aroused a widespread interest in some aspects of the subject, of which the Press has not been slow to take note. Not even the heuristic method can hide from the schoolboy the fact that certain fundamental conceptions are accepted which do not admit of proof, such as the indivisible atom, the non-decomposable element, the indestructibility of matter. When, therefore, as one of the first-fruits of his discovery that positive rays furnish the most delicate method of chemical analysis, Sir J. J. Thomson has obtained from the most diverse solids a new gas, X_3; and by a different procedure, Prof. Collie with Mr. Patterson have discovered that hydrogen, under the influence of electric discharges at low pressure, becomes replaced by neon, helium, and a third gas which is possibly identical with X_3,[2] it is not surprising that we should hear much about it in the newspapers, just as was the case when the disintegration of radium was in process of being established. Further investigation may fail to substantiate some of the views which have been expressed about this unexplained disappearance of hydrogen; the origin of the neon and helium which make their appearance in the tube as the experiments proceed; the source of the gas X_3. Fortunately, X_3, unlike neon and helium, has some chemical properties—it disappears, for example, when violently exploded with a mixture of oxygen and hydrogen[3]—but we do not yet know whether it is a new element with an atomic weight of about 3, or a compound of hydrogen with an element yet to be discovered. This much at least seems certain: it is not the gas which, according to Mendeleef, should precede fluorine in the halogen series, but whether its discovery, like that of argon, will necessitate a revision of the periodic table of the elements we cannot know until the mystery which at present surrounds it has been dispelled.

It was in 1886, at the last meeting of this association in Birmingham, that Sir William Crookes—whose continued activities are a source of pride and gratification to his brother chemists—gave that famous address in which, clothing his ideas in language which has something of the magic of word-painting, he traced the evolution of the elements, as we know them, from the hypothetical protyle or Urstoff. The common origin of all elementary substances is now an accepted theory, although the question whether the idea underlying the term "transmutation" is verifiable under available conditions is answered differently according to the view we take of the disintegration of radium and kindred phenomena. But no one could have imagined that before another Birmingham meeting, the periodic table to which Sir William Crooks devoted much attention would have been enriched not only by a series of

[1] These schools in 1881 became the Normal School of Science, and in 1900 the Royal College of Science, now incorporated in the Imperial College of Science and Technology.

[2] J. N. Collie and H. S. Patterson, Trans. Chem. Soc., 1913, ciii., 419; Proc. Chem. Soc., 1913, xxix, 217.

[3] Sir J. J. Thomson, Proc. Roy. Soc., 1913, lxxxixA. 20.

elements devoid of chemical properties, but by a second series, known only in minute quantities, and displaying those extraordinary properties of radioactivity which have revolutionised our ideas in more than one direction.

It is not necessary for me to chronicle even the more striking achievements in chemistry since 1886; a few examples will show how great the progress has been. It is on record that Arrhenius was present at that meeting, but his advocacy of that theory of solutions with which his name will always be associated came a little later; phenylhydrazine, which was to play so important a part in Emil Fischer's investigation of the sugars, had been discovered by him only two years previously; the Grignard reagent, which in other directions has played a no less important part in synthetical organic chemistry, did not become available until some fourteen years later. Theories then emerging, such as that of geometrical isomerism, have either been discarded or modified by the discovery of new facts, and who shall say that the ionic theory of dissociation stands where it did, now that ions in solution have incurred the suspicion of associating with the solvent, and to that extent have come into line with molecules, for the orthodox behaviour of which Prof. Armstrong himself would no doubt be prepared to vouch.

Residual Valency.

Among the many doctrines which have suffered under the stress of long-sustained investigation, that of valency is a prominent example. Valency is that property by which an atom attracts to itself other atoms or radicals, and its numerical value is deduced from the structural formulæ of compounds in which that atom occurs. Claus seems to have been the first to recognise that this attraction between two atoms is not a constant, but depends on the nature of the other atoms or radicals in the molecule,[4] and it is of interest to note in connection with what follows that he used methane and its chloro-derivatives to illustrate his point of view. Valency may vary, therefore, from compound to compound; it is known to alter under the influence of change in temperature, as, for example, when carbon dioxide or phosphorus pentachloride undergoes thermal dissociation. But Claus's view did not meet with ready acceptance; hence at the Birmingham meeting few chemists, if any, would have questioned the quadrivalency of carbon, despite the difficulty caused by the existence of carbon monoxide. Now, carbon is believed to be bivalent in the carbamines, fulminic acid and other compounds, as well as in carbon monoxide, and its tervalency is coming to be accepted in the light of the latest investigations on triphenylmethyl and its congeners. What is true of carbon is equally true of all other elements, except argon and its companions. Hence the doctrine of constant valency for which Kekulé contended, or that of variable valency in which the uncombined units varied by even numbers has necessarily given place to one of less rigid type, although the final form has yet to be determined.

For the purpose of this address it will be sufficient to refer only to one of these later theories: that in which Werner, as the outcome of his exhaustive study of inorganic molecular compounds, and especially of the ammines, supposes that an atom may have both principal and auxiliary or residual valency.[5] There are difficulties in its application to certain problems of organic chemistry—for example, the structure of the benzene molecule—but the conspicuous success which has attended Werner's investigation of the complicated isomerism of the cobalt and chromium ammines is evidence of its value as a guide in stimulating research in the most unpromising directions.[6] Werner's view that valency is an attractive force acting from the centre of the atom, being of equal value at all points on the surface and independent of units of affinity, has the merit of meeting the objection long urged to the idea that affinity has fixed direction in space, but otherwise leaves untouched Van't Hoff's brilliant conception of asymmetry which plays so great a part in the chemistry of to-day.

What light does this conception of residual valency, dating back to 1885, if not earlier,[7] and now embodied in many theories besides Werner's, throw on some of the problems with which the organic chemist is faced? Much every way. The question of the distribution of valency in the molecules of carbon compounds is discussed probably more than any other; it arises in connection with the structure of unsaturated compounds, the properties of fluorescence or colour which many of them exhibit, and the relation between chemical constitution and physical properties, to the elucidation of which an increasing amount of research is being directed. The double linkings in our formulæ no longer represent two units of valency in terms of hydrogen, nor are they now used to indicate polarity of the central atom or distribution of the valency in space; Werner's conception of valency accounts, as the phrase goes, for the concentration of re-activity at that part of the molecule where unsaturation exists, and it is of service when different degrees of unsaturatedness are displayed by compounds which, on the older view, would be expected to show similarity in chemical behaviour.[8] With your permission I propose briefly to review our knowledge of that type of chemical change known as substitution from the point of view of residual valency.

Substitution in the Paraffin Series.

So far back as 1839 the fact was discovered that replacement of hydrogen by chlorine in the acetic acid molecule does not lead to any essential modification in the properties of the acid. It is not a little remarkable, therefore, that although much of the progress in organic chemistry has been achieved by substitutions of the most diverse types, we are still unable to say that agreement has been reached with regard to the nature of the processes by which this replacement of one radical by another in a molecule is brought about. Never has attention been concentrated more closely than now on the study of what, for want of a better phrase, is termed the "mechanism of chemical reactions"—the processes which are covered and hidden by the sign of equality used, inaptly, in chemical equations—but the integrating mind, to the need for which Professor Frankland alluded on a recent occasion,[9] has not yet been evolved to reconcile the uncertain or contradictory answers vouchsafed to much patient experimenting. Organic

4 A. Claus, *Ber.*, 1881, xiv, 435. It may be noted that Claus concludes his paper with the statement, ". . . die Annahme von Valenzen, als in den mehrwerthigen Atomen präexistirender ihrer Wirkungsgrösse nach bestimmter Anziehungseinheiten eine ebenso unbegründete, wie unnatürliche Hypothese ist."

5 A. Werner, "Neuere Anschauungen auf dem Gebiete der anorganischen Chemie" (Friedr. Vieweg u. Sohn, Braunschweig, 1908): English edition. "New Ideas on Inorganic Chemistry." E. P. Hedley. (Longmans, 1911.)

6 A. Werner, *Ber.*, 1911, xliv, 2445, 3231.

7 S. U. Pickering, Proc. Chem. Soc., 1885, i, 122; H. E. Armstrong, Proc. Roy. Soc., 1886, xl, 285.

8 As an example of the unsatisfactory character of the doubly-linked formula to which the older meaning was attached, the following may be quoted: *unsym.*-Diphenyldichloroethylene, like ethylene, combines molecularly with bromine, but tetraphenylethylene does not:

$$\begin{array}{c} CH_2 \\ \| \\ CH_2 \end{array} \qquad \begin{array}{c} C(C_6H_5)_2 \\ \| \\ C\,Cl_2 \end{array} \qquad \begin{array}{c} C(C_6H_5)_2 \\ \| \\ C(C_6H_5)_2 \end{array}$$

yet a similar structure has been assigned to each (Biltz, *Annalen*, 1897 ccxcvi, 219).

9 P. F. Frankland, Proc. Chem. Soc., 1913, xxix, 101.

chemistry is not singular in this respect: as much might be said about controversies not yet settled which concern themselves with such every-day phenomena as the chemistry of the candle-flame or of the rusting of iron.

It is a commonplace that Kekulé, to whom theoretical chemistry owes so many fruitful suggestions, was of the opinion that substitution is not a process in which what may be called a direct exchange of radicals occurs, but is preceded by the temporary union of the molecules of carbon compound and addendum, followed by disruption into two new molecules, the substituted carbon compound being one of them. It is clear, then, from the point of view of Kekulé's hypothesis, that some degree of unsaturation is to be looked for in all carbon compounds and in all addenda. Hence, the paraffin hydrocarbons which furnish derivatives only by substitution, and, under the older, more rigid view of valency propounded by Kekulé himself, are typically saturated compounds, supply the exceptions to prove the general validity of the hypothesis that addition precedes substitution.

Before examining the case of these hydrocarbons, however, some advantage may be gained if the behaviour of other groups of compounds be examined in the light of the idea underlying Kekulé's view. By reference to the literature, it is evident that since the beginning of this century attention has been concentrated on the phenomena of substitution in the important group of carbonyl compounds, particularly the ketones and acids, which in many cases yield halogen substitution derivatives of one type. Thus methyl ethyl ketone when brominated in sunlight yields two bromoketobutanes of the constitution shown in the following formulæ, and propionic acid with bromine and red phosphorus under Volhard's conditions [10] gives α-bromopropionic acid,

$$CH_2Br.CO.CH_2.CH_3 \text{ and } CH_3.CO.CHBr.CH_3\ ^{11}$$
$$CH_3.CHBr.CO.OH$$

the halogen occupying what is termed the α-position with reference to the carbonyl radical. Why is substitution easier in the methyl group when it is present in the ketone or acid than when it occurs in methane, is one question that may be asked. A second will inquire whether the carbonyl group has a directing influence, and, if so, by what means is it exercised.

It has been supposed by Werner that the distribution of valency is disturbed by the introduction of the oxygen atom of the carbonyl group into the molecule of the hydrocarbon; that this oxygen atom absorbs much of the valency of the carbon atom of the carbonyl group, leaving less to bind its neighbour or neighbours, which results in their having free valency, and thereby attaching substituents to themselves. This explanation, if accepted for the bromination of ketones and acids, also for the chlorination of ketones, does not account for the results recorded by Michael and by Montemartini in the case of carboxylic acids. Michael has found that the β-chloro-, not the α-chloro-acid is the chief product (60–65 per cent.) when homologues of acetic acid are chlorinated [12]; and Montemartini states that if the radical CH occur in any part of the carbon chain the exchange of hydrogen for chlorine takes place in that position, however distant it may be from the carbonyl group of the acid.[13]

[10] J. Volhard, *Annalen*, 1887, ccxlii, 141; *Ber.*, 1888, xxi, 1904.

[11] L. Van Raymerant, Bull. Acad. roy. Belg., 1900, 724. For the chloroketobutanes, cf. *idem.*; Kling, Compt. rend. 1905, cxl, 312; Bull. Soc. chim., 1905 [iii], xxxiii, 322.

[12] A. Michael, *Ber.*, 1901, xxxiv, 4035, 4046.

[13] C. Montemartini, Gazz. chim. ital., 1897, xxvii [ii], 368; 1898, xxviii [ii], 290.

$$CH_3.CH_2.CHCl.CH_2.CO.OH$$
(Michael)

$$\left.\begin{matrix}CH_3\\CH_3\end{matrix}\right\rangle CCl.CH_2.CH_2.CO.OH$$
(Montemartini)

At present there seems to be no clue to the reason why chlorine and bromine in these reactions behave alike towards ketones and not towards acids.

An alternative explanation of this reaction, which has come to be widely accepted, is based on the remarkable property called desmotropy or dynamic isomerism, which certain of these carbonyl compounds exhibit. A desmotropic compound may exist in two or more forms, and its peculiar isomerism is known to depend on the mobility of a hydrogen atom in the complex $.CH_2.CO.$ whereby an equilibrium is set up of the type:

$$\underset{\text{Ketonic form}}{.CH_2.CO.} \rightleftharpoons \underset{\text{Enolic form}}{.CH{:}C(OH).}$$

Of these two forms, the enolic is the more unsaturated, and presumably the more reactive.[14] Lapworth, making use of this desmotropic relationship, supposes that when the ketone reacts with halogen in dilute aqueous solution three changes occur which, for the case of acetone, may be represented by the following expressions:—

$$\begin{aligned}&CH_3.CO.CH_3 &&\rightarrow CH_3.C(OH){:}CH_2\\&CH_3.C(OH){:}CH_2+Br_2 &&\rightarrow CH_3.C(OH)Br.CH_2Br\\&CH_3.C(OH)Br.CH_2Br &&\rightarrow CH_3.CO.CH_2Br+HBr\end{aligned}$$

the first being one of slow enolisation, accelerated catalytically by halogen acid, leading to the production of an unsaturated compound, which then by rapid addition of bromine and subsequent elimination of hydrogen bromide conforms with Kekulé's hypothesis. The intermediate compounds, it is true, have not been isolated, but a study of the dynamics of the reaction by Lapworth, and later by Dawson with his collaborators (using iodine instead of bromine), shows that this explanation is in harmony with the data obtained.[15] When the reaction is applied to carboxylic acids under similar conditions, the view that it takes a similar course finds support from an investigation of the dynamics of the bromination of malonic acid in aqueous solution.[16]

Whether evidence drawn from reactions found to take place in aqueous solution is relevant when bromination is effected by heating a carboxylic acid with bromine and red phosphorus may be doubted. Certainly it seems to afford no assistance in accounting for the course of chlorination in the acids examined by Michael and by Montemartini. Nevertheless, Aschan employs the keto-enolic hypothesis [17] to elucidate the results of a recent inquiry into the "mechanism" of the Volhard reaction [18]; and it may be added that racemisation has been found to occur when *laevo*-valeric acid is brominated by Volhard's method [19]—a result which must follow if enolisation

[14] It may be of interest to note that the long controversy respecting the composition of ordinary ethyl acetoacetate $CH_3.CO.CH_2.CO.OEt$, the first of these desmotropic compounds to be discovered, has been brought to an end by the isolation of each desmotropic form at temperatures sufficiently low to inhibit the desmotropic change. From refractometric observations with mixtures of the pure isomerides, Knorr concludes that this ester at the ordinary temperature contains about two per cent. of the enolic form, whereas from bromination experiments with the ester itself, which may possibly be accompanied by a disturbance of the equilibrium, K. H. Meyer infers that the amount may be as much as seven per cent. (L. Knorr, O. Rothe, and H. Averbeck, *Ber.*, 1911, xliv, 1138; K. H. Meyer, *Annalen*, 1911, ccclxxx, 222; K. H. Meyer and P. Kappelmeier *Ber.*, 1911, xliv, 2718.]

[15] A. Lapworth, Trans. Chem. Soc., 1904, lxxxv, 31; H. M. Dawson with May S. Leslie, *ibid.*, 1909, xcv, 1860; with R. Wheatley, *ibid.*, 1910, xcvii, 2048; with F. Powis, *ibid.*, 1912, ci, 1503.

[16] K. H. Meyer, *Ber.*, 1912, xlv, 2867.

[17] O. Aschan, *Ber.*, 1912, xlv, 1913; 1913, xlvi, 2162; K. H. Meyer, *Ber.*, 1912, xlv, 2868.

[18] J. Volhard, *loc. cit.*

[19] O. Schütz and W. Marckwald, *Ber.*, 1896, xxix, 58.

take place, although susceptible of another explanation.

So far as I can form a judgment, no case has been made out for the view that substitution of halogen for hydrogen under Volhard's conditions differs in its "mechanism" from substitution in the paraffins. This opinion finds support in the discovery just announced by Leuchs[20] that, while the chief product of the bromination of *dextro*-β-carboxybenzyl-α-hydrindone

$$C_6H_4\begin{array}{l}\diagup CH_2 \diagdown \\ \diagdown CO \diagup\end{array} CH.CH_2.C_6H_4.CO_2H \rightarrow$$

$$C_6H_4\begin{array}{l}\diagup CH_2 \diagdown \\ \diagdown CO \diagup\end{array} CBr.CH_2.C_6H_4.CO_2H$$

is the racemic compound, no less than 10 per cent. is the *dextro*-bromo-derivative; therefore, the inference is clear that in the formation of the latter compound, if not of both, substitution was effected by a process in which migration of the hydrogen atom did not occur.

Attention may now be directed to the question of "direct substitution," which, in its simplest form, is encountered in the paraffin series. As will be gathered from the following selection from among the various theories propounded to account for the mechanism of substitution, alternative explanations of the intermediate reactions leading up to substitution in these cases involve either elimination of the hydrogen atom before introduction of the halogen, or addition of the halogen in virtue of the supposed residual valency of both molecules, followed by disruption of the complex thus formed into the known products of the change.

Dealing with these alternatives in the order given, Arrhenius adopts a view of the process of substitution which, including as it does his explanation of optical inversion and racemisation, should perhaps be given in his own words:—

"Every valency linking can be broken; this is true in all cases, since it is a necessary condition for every chemical reaction. An atom or an atomic complex is thereby removed from the molecule, and its place taken by another atom or atomic complex. One must therefore assume, as was first pointed out by Williamson, that the atoms or complexes separate themselves from the molecule from time to time, even when they do not react with other molecules. Consider now a molecule in which four different atoms, A, B, C, and D, are bound to one carbon atom. The atoms A and B, which may possess equal charges, *e.g.* positive, are therefore separated at times from the molecule, and it may happen that they are both separated at one and the same time. It is therefore possible for them to change places on combining with the carbon atom again. This is synonymous with a transformation of the original molecules into its optical isomer."[21]

Nef, making use of "the conception of dissociation in its broadest sense," is of opinion that the decomposition of ethane into hydrogen and ethylene at 800° "proves that an extremely small per cent. of [its] molecules must exist at ordinary temperature in an active or dissociated condition,

$$CH_3.CH_3 \rightarrow CH_3.CH_2 + H-\text{''}^{22}$$

consequently, when "chlorine reacts with ethane to give the monochloro-substitution product, we have this reagent in the *active molecular* condition simply uniting by addition with the dissociated ethane particles,

$$\begin{array}{c}Cl=Cl\\ |\end{array} + H-C_2H_5 \rightarrow \begin{array}{cc}\multicolumn{2}{c}{Cl=Cl}\\ | & |\\ H & C_2H_5\end{array} \quad [\rightarrow \; HCl+C_2H_5Cl.]\text{''}$$

Finally, he draws the conclusion that "excluding reactions called ionic, a chemical reaction between two substances always first takes place by their union to form an additive compound."

Michael,[23] in many published papers, has emphasised the view that in the substitution of halogen for hydrogen in a saturated hydrocarbon or saturated acid the principal factors to be taken into account are the mutual chemical attraction of the two elements, on one hand, and that of the halogen and carbon, on the other. By applying his "positive-negative" hypothesis to the directing influence of "relatively-positive" methyl, and "relatively-negative" carboxyl, he draws conclusions about the degree of firmness or looseness with which particular hydrogen atoms are bound to carbon in the molecule, and is thereby able to forecast with some success the position or positions in which replacement of hydrogen by halogen will occur. Flürscheim, in the discussion of the relation between the strength of acids and bases, and the quantitative distribution of affinity in the molecule, also makes use of the idea that the relative degree of firmness or looseness with which a hydrogen atom is held depends on the nature of the other atoms or radicals associated with the same carbon atom.[24] The hydrogen atoms therefore are not to be regarded as retained in the molecule with the same degree of firmness; in other words, valency is not a constant to be measured in units.

It will be gathered therefore that Arrhenius and Nef, from different points of view, support the idea that separation of hydrogen from the hydrocarbon precedes entry of the substituent into the molecule; Michael and Flürscheim are concerned chiefly with the distribution of valency in the molecule, which determines whether a particular hydrogen atom shall be displaced by hydrogen or not; Kekulé's hypothesis requires addition to precede substitution. Is there any experimental evidence to indicate where the balance of probability lies? I think it can be argued that the phenomena of substitution observed with optically active substances do not lend support to the views of Arrhenius or of Nef, which imply actual or virtual dissociation, but that they point to the intermediate formation of an additive product, which undergoes scission as Kekulé supposed. Such an additive product can be formed only if residual valencies be present in both carbon compound and addendum.

The argument runs thus: Unless valency has fixed direction in space, a conception now abandoned if modern theories of valency be accepted, the conclusion seems to be inevitable that dissociation of the optically active compound:—

$$CWXYZ \text{ into } CWXY+Z,$$

must lead to racemisation, the radicals W, X, Y, distributing themselves in two-dimensional space, thus destroying the asymmetry; whence it follows that introduction of the substituent, V, into the molecule in place of Z can give rise only to an optically inactive product. Now, it is a well-established fact that a radical attached directly to the asymmetric carbon atom may be replaced by another without racemisation following.[25] Therefore, preliminary dissociation being excluded, Kekulé's additive hypothesis remains. But the prolonged study of that remarkable reaction known as the "Walden inversion" by Emil Fischer, McKenzie, and other investigators, has led to results

[20] H. Leuchs, *Ber.*, 1913, xlvi, 2435.
[21] S. Arrhenius, "Theories of Chemistry," edited by T. Slater Price (Longmans, 1907), p. 76.
[22] J. U. Nef, "The Fundamental Conceptions underlying the Chemistry of the Carbon Atom," J. Amer. Chem. Soc., 1904, xxvi, 1566.

[23] A. Michael, *Ber.*, 1901, xxxiv, 4028, covering reference to earlier papers.
[24] B. Flürscheim, Trans. Chem. Soc., 1909, xcv, 721.
[25] P. Walden, *Ber.*, 1895, xxviii, 1297; W. Tilden and B. M. C. Marshall, Trans. Chem. Soc., 1895, lxvii, 494.

which, if the views formed independently by Fischer,[26] Werner,[27] and Pfeiffer [28] may be accepted, are inexplicable unless a preliminary addition, effected as it is supposed by means of residual valencies, precedes this replacement of the eliminated radical by the substituent.

The Walden inversion may be illustrated by a brief statement of some of the facts discovered in connection with the conversion of optically active chlorosuccinic acid into malic acid

$$R.CH(OH).CO_2H \longrightarrow R.CHCl.CO_2H \longrightarrow R.CH(OH).CO_2H.$$

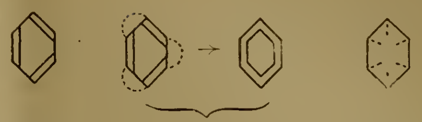
Walden found that *laevo*-chlorosuccinic acid, obtained from *dextro*-malic acid, furnished either *dextro*- or *laevo*-malic acid, according to the reagent used to effect of the replacement of the Cl by the OH radical.

$$l\text{-chlorosuccinic acid} \begin{cases} (+\,Ag_2O) \rightarrow l\text{-malic acid} \\ (+\,KOH) \rightarrow d\text{-malic acid.} \end{cases}$$

And as the corresponding inversion was found to occur with *dextro*-chlorosuccinic acid under similar conditions, a complete cycle of changes can be brought about.[29] That preservation of optical activity, and not racemisation, should accompany the replacement of a radical, attached to the asymmetric carbon atom, by another is a fact of much theoretical interest, as has already been indicated; that a change in the sign of rotation should occur when an exchange of the same radicals is achieved by one reagent and not by another is a mystery, that deepens rather than diminishes with each addition to the list of inversions, already long, in which it has been observed.[30] In all probability the discovery of the Walden inversion, as Prof. Frankland has said, "may mark an epoch in our views with regard to the mechanism of the process of substitution in general." [31]

The Structure of the Benzene Molecule.

The abandonment of the theory of the fixed valency unit in favour of the view that the carbon atom has both principal and residual valencies has raised afresh that perennial topic of controversy—the structure of the benezene molecule. Probably few will contest the statement that for practical purposes only three formulæ have emerged from the long discussion of the problem, viz. Kekulé's oscillation formula with fixed valency units, for which much physical evidence has been pleaded: Thiele's formula, in which his theory of "conjugated double linkings" is applied to the Kekulé formula, with the consequence that the three double linkings disappear owing to self- neutralisation of the partial valencies, the benzene molecule thus containing six inactive double linkings; [32] and Armstrong's "centric" formula, in which by its residual valency "each individual carbon atom exercises an influence upon each and every other carbon atom." [33] The dotted lines indicate the residual valencies.



Kekulé. Thiele. Armstrong.

The discovery of *cyclo*octatetraene has brought a new interest into the discussion,[34] for the structural formula assigned to this hydrocarbon shows alternate single and double linkings as in Kekulé's symbol, and the optical behaviour (refractivity) corresponds with that of benzene.

CH=CH
CH CH
| ||
CH CH
CH=CH

But its chemical properties are entirely different from those of benzene; it forms compounds not by substitution but by addition, and it has the reactivities of a highly unsaturated compound. If these experimental results be accepted, then—as Willstätter shows—the peculiar properties of benzene are not to be explained by Kekulé's or Thiele's formula, and the verdict is given in favour of the "centric" symbol—that earliest embodiment of the conception of residual valency, which Armstrong later turned to such good account in the quinonoid theory of colour identified with his name.

The reference to the optical behaviour of *cyclo*-octatetraene may perhaps suggest the inquiry: Do not the physical properties of the carbon compounds throw light on the questions that have been raised? A little consideration will show that, on the contrary, the answer must be: It is only by chemical evidence that physical data can be interpreted or corroborated, and in the absence of such evidence the "additive" results which accrue from physical observations have no bearing on questions involving the determination of structure or the structural transformations which accompany a chemical change. For example, the anomalous results obtained by Brühl and by Sir William Perkin [35] in the investigation of the refractivity and the magnetic rotation of certain unsaturated compounds, remained without explanation until Thiele in 1899, by his hypothesis of partial valency, accounted for the comparative inactivity of the central pair of carbon atoms in compounds of this type—compounds which are characterised by containing alternate single and double linkings in their formulæ:—

. CH : CH . CH : CH . → . CHBr . CH : CH . CHBr .

This conception of Thiele's has both focussed attention on the distribution of valency within the molecule, contributing largely to the wide acceptance of theories of valency such as Werner's, and given to the study of physical properties—especially those "constitutive" properties of refraction, dispersion, and magentic rotation—an impetus which has by no means spent its force. Further, the occurrence of this anomaly, "exaltation" as it is called, is now relied on as evidence of the presence of this particular distribution of valency, with results which in Auwers's

26 E. Fischer, *Annalen*, 1911, ccclxxxi, 123.
27 A. Werner, *Ber.*, 1911, xliv, 873.
28 P. Pfeiffer, *Annalen*, 1911, ccclxxxiii, 123.
29 P. Walden, *Ber.*, 1896, xxix, 133; 1897, xxx, 3145; 1890, xxxii, 1833, 1855.
30 Without the aid of a model it is not possible to show that the production of the *dextro*- or *lævo* acid may be accounted for by the hypothesis that an intermediate additive compound is formed, which undergoes scission in one or other of two ways. Diagrams of models will be found in Fischer's paper (*loc. cit.* cf. "Annual Reports on the Progress of Chemistry" (Gurney and Jackson, 1911, viii, 67), and to illustrate Werner's hypothesis, which is more exolicit than Fischer's, in a paper by W. F. Garner (Proc. Chem. Soc., 1913, xxix. 200)
31 P. F. Frankland, "The Walden Inversion," Presidential Address to the Chemical Society (Trans. Chem. Soc., 1913, ciii, 713).
32 J. Theile, *Annalen*, 1899. cccvi, 126.
33 H. E. Armstrong, Trans. Chem. Soc., 1897, lr, 264 (footnote),
34 R. Willstätter and F. Waser, *Ber.*, 1911, xliv, 3423.
35 *Cf.* J. W. Brühl, *Ber.*, 1907, xl, 878; Sir W. H. Perkin, Trans. Chem. Soc., 1907. xci, 806, for references to earlier papers.

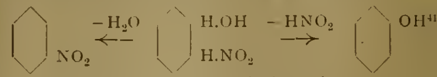
hands have furnished important clues to the structural formulæ of terpenes and other compounds.

As additive properties become constitutive, so the value of a knowledge of the physical properties of a substance will tend to increase, but there is little ground for hope that the problem of the constitution of benzene will be solved from the physical side. The controversy which has arisen between Hantzsch and Auwers regarding the physical properties of *cyclo*-tatetraene in relation to its chemical structure is a case in point;[36] the absence of optical exaltation in this hydrocarbon is wholly unexpected, but, on the other hand, the type of compound is entirely new. With benzene also the distribution of valency within the molecule differs from that in any known compound; our knowledge of it, admittedly far from complete, has been gained from the chemical side, and is summarised in the various structural formulæ; but the limitations of the physical method of attack can be traced from Thomsen's endeavour to determine its structure from thermochemical data[37] to the more recent invention of isorropesis. And, despite the evidence obtained from refractivities, we may not unreasonably demur to the suggestion that derivatives of benzene, which by their behaviour towards substituting agents show themselves to be wide apart in chemical properties, such as nitrobenzene and aniline on one hand or chlorobenzene and phenol on the other, should respectively be classified together.[38]. Undoubtedly, most useful information is obtained from a comparison of the physical properties of two related substances, the exact constitution of one of which is uncertain, but that of the other known. Therefore, bearing in mind the great development that has taken place recently in the correlation of physical properties with chemical constitution by methods based on refraction and absorption, every chemist will welcome the entry of Dr. Lowry into that field of research on the relation between magnetic rotation and structure, which for all time will be associated with Sir William Perkin's name.

Substitution in the Benzene Series.

Turning now to a discussion of the problem of substitution in cyclic compounds, one important factor must not be overlooked; the even distribution of the residual affinity of the benzene molecule is disturbed by the introduction of a substituent. The study of substitution in benzene derivatives indicates that, as a consequence of this disturbance, a directing influence comes into play which, when the substituent is changed, may vary in the effect it exercises on the course of substitution.

Arising probably from this even distribution of valency, it is characteristic of benzene to furnish additive compounds in which six atoms of hydrogen or a halogen, but not two or four, become attached symmetrically to the molecule; substitution, however, occurs when a catalyser is present, such as the aluminium-mercury couple for halogenation, or sulphuric acid for nitration or sulphonation, leading initially to the production of mono-substituted derivatives. Whether the catalyser by association with the benzene molecule[39] limits this additive capacity, or whether its function is to promote the elimination of the halogen acid or water respectively,[40] is still a subject of discussion, but in the absence of a reaction of additive type it is not easy to account for facts such as the production of a certain amount of trinitrophenol when benzene is nitrated in the absence of sulphuric acid.



(in presence of sulphuric acid) (in absence of sulphuric acid)

The much-debated questions still remain: Why and by what mechanism, when a second or third substituent is introduced into the molecule, is the orientation of the isomeric products determined by the radical or radicals already present? For disubstitution, the *ortho-para*- and the *meta*-laws have been deduced, and the radicals which respectively promote mainly *ortho-para*-substitution on one hand, and *meta*-substitution on the other, have been catalogued.[41] But these laws take account only of the orientation of the chief product or products, whereas all three derivatives, *ortho*, *meta*, and *para*, have been detected in most of the reactions studied, and their relative proportion in many cases is known to depend on the conditions, being affected by such influences as variation in temperature or in the medium employed.[42] Nitration of acetanilide, for example, furnishes a mixture of *ortho*- and *para*-nitracetanilide, but of aniline in the presence of much sulphuric acid yields chiefly *meta*-nitraniline.[43] And, to illustrate the inadequacy of the *meta*-law, the fact that sulphonation of benzene-sulphonic acid with concentrated sulphuric acid at 230°–240° furnishes an equilibrium mixture of the *meta*- and *para*-disulphonic acids in the proportion of 2 : 1 may be quoted.[44]

In the exploration of this field many workers have participated, but the results, recorded almost as often in patent specifications as in journals, are seldom quantitative, so great is the difficulty at times in isolating the minor product or products of the change. Recently, however, by a most ingenious use of melting-point curves and density determinations, Holleman and his collaborators have carried out an exhaustive series of substitutions with small quantities of material and under known conditions;[45] yet after a survey of the whole field the conclusions reached are:—

(1) That uncertainty cannot be removed until some basis exists for different reactions to be carried out under comparable conditions.[46]

(2) That even if the relative amounts of the isomerides formed when a radical C is introduced into each of the mono-substitution derivatives $C_6H_5.A$ and $C_6H_5.B$ be known, it is not possible to calculate the proportion in which the isomerides $C_6H_3.ABC$ will be produced when the radical C is substituted in the compound $C_6H_4.AB$.

Although the validity of the *ortho-para* and of the *meta*-laws may be impeached, they serve as a first approximation, and many theories have been propounded to account for them. Armstrong has suggested that in *ortho-para*-substitution the additive compound is formed by association of the addendum with the carbon atom carrying the radical already substi-

36 A. Hantzsch, *Ber.*, 1912, xlv, 563; K. Auwers, *ibid.*, 971.

37 *Cf.* H. E. Armstrong, Phil. Mag., 1887 [v.] xxiii, 73; J. W. Brühl, J. pract. Chem., 1887 [ii], xxxv, 181, 209.

38 *Cf.* J. W. Brühl, Zeit Physikal. Chem., 1894, xvi, 220; Smiles, "Relations between Chemical Constitution and Physical Properties" (Longmans, 1910), p. 299.

39 B. N. Menschutkin, Abstr. Chem Soc, 1912, cii, i, 98–100.

40 *Cf.* H. E. Armstrong, Trans. Chem. Soc., 1887, li, 263.

41 The phenol by nitration forming the trinitro- derivative (picric acid), Armstrong and Rossiter, also Groves. Proc. Chem. Soc., 1891, vii, 89.

42 *Cf.* Noelting, *Ber.*, 1876, ix, 1797; Armstrong. Trans. Chem. Soc., 1887, li, 258; Crum Brown and Gibson, *ibid.*, 1892, lxi, 367.

43 Hübner, *Annalen*, 1881, ccviii, 299.

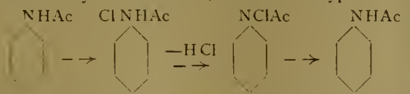
44 J. J. Polak, *Rec. trav. chim.*, 1910, [ii.] xiv, 416; R. Behrend and M. Mertelsmann, *Annalen*, 1911, ccclxxviii, 352.

45 A. F. Holleman, "Die direkte Einführung von Substituenten in den Benzolkern" (Leipzig, Viet and Co., 1910), p. 215.

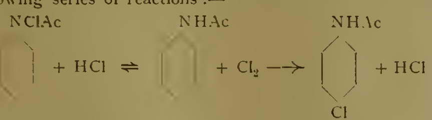
46 For example, nitration is effected chiefly at low temperatures, but sulphonation of mono- substituted benzenes at temperatures higher than the ordinary, which if employed in nitration would lead to mixed products.

tuted in the molecule,[47] whereas in *meta*-substitution it arises by union of the addendum with this radical,[48] transformation to the respective disubstitution derivatives being effected possibly in step-by-step progression, as conjectured by Lapworth.[49] Holleman, who also adopts the additive hypothesis, is of the opinion that the radical already present in the molecule may promote or retard the association of the addendum with the pair of carbon atoms, to one of which it is itself attached. By the operation of the first of the alternatives an *ortho*- and by conjugation a para-derivative will arise; from the second a *meta*-derivative will result, when scission of the additive compound ensues. Holleman's is the only hypothesis which has been submitted to the test of quantitative investigation, and although, as already mentioned, the results do not suggest that finality has been reached, it marks an advance in the study of this obscure problem.[50]

No discussion of substitution in the benzene series would be adequate without reference to the remarkable behaviour of amines and phenols. Unlike other mono-substitution derivatives, which do not differ markedly from benzene in reactivity, these furnish mono-, di-, and tri-derivatives very readily. With aniline or acetanilide, substitution occurs first of all in the side chain, being followed under appropriate conditions by removal of the substituent from the amino-group and entry into positions relatively *ortho*-, *para*-, or both *ortho*- and *para*- to it. The earliest of these changes to be studied was the transformation of methylaniline into *para*-toluidine; many of them have been discovered by Chattaway and his collaborators, and until a critical study of the chlorination of acetanilide was undertaken by Orton and Jones,[51] it was held that the changes, which occur only in the presence of hydrochloric acid, were of the type :—

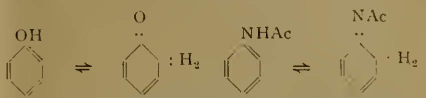


From the dynamics of the reaction, it is now known that intra-molecular transformation from the side chain to the ring does not occur, the agent promoting the substitution being chlorine arising from the following series of reactions :—



As bromination has been shown to follow the same course, it is evident that no secure foundation now exists for the view, formerly widely held, that the reactivity of amines is intimately connected with the variable valency of nitrogen leading to initial substitution in the side chain.

Even were this view, now discredited, still applicable to the amines, it could not be extended with the same certainty to the phenols. Hence, in explanation of the rigid adherence to the *ortho-para*-law observed among the mono-substitution derivatives of these two groups of compounds, it is noteworthy that Thiele,[52] for the phenols, suggests that the reactivity may be due to these substances being stable enolic forms of ketodihydrobenzenes, and that Orton,[53] for the amines, conjectures that it may arise from the formation of dynamic isomerides of quinonoid structure :—



How far these suggestions may open up a new field of inquiry into the "mechanism" of substitution remains to be seen; it is at least interesting that their extension to the naphthalene series shows that not only does the reactivity of the naphthols and of α-naphthylamine recall that of phenol and aniline, but the orientation of their mono-substitution derivatives[54] in almost every case is the same as that of one or other of the six naphthaquinones, the existence of which has been predicted by Willstätter.[55]

Symmetric and Asymmetric Syntheses.

It must not be supposed that the "mechanism" of substitution can be explained by reference only to the examples of this type of reaction which have been mentioned, or that the summary attempted in the restricted field of the replacement of hydrogen by halogen is a complete picture of all the different views advanced to account for this chemical change. Rather, the effort has been made to indicate in broad outline the difficulties that beset any exploration of that debatable region which lies between the two sides of a chemical equation. But, as the wonderful story of carbon chemistry shows, the failure to comprehend the processes operative in substitution does not impede rapid progress in other directions. The study of the mobility of radicals, desmotropy being only one of many examples of this phenomenon, continues to present fresh problems, of which that raised by Thorpe[56] in connection with the mobile hydrogen atom of glutaconic and aconitic acids may be mentioned, as it revives a question of old standing: Do free units of valency exist in carbon compounds? The syntheses of caffeine and certain alkaloids, of sugars and peptone-like polypeptides, of natural terpenes and camphor, of indigo and rubber, are well-known achievements, while natural processes, in which enzyme action plays a part, are yielding their closely guarded secrets to the persistent inquiry of Armstrong and his collaborators, who are probing the relationship between enzyme and substrate which Emil Fischer pictured as that of lock and key. Further, there is that large field of work which includes not only the Walden inversion but new problems of asymmetry, with which the names of Frankland, Pope, Werner, and others are associated; while Barlow and Pope's conception of the relation of valency to atomic volume, by correlating crystalline structure with the composition, constitution, and configuration of carbon compounds, has given a new interest to the study of crystallography.

Nor is progress less rapid in that other important branch of chemistry—the unravelling of the structure

[47] Kinetic studies of the chlorination and bromination of toluene, $C_6H_5{\cdot}CH_3$, however, gave no indication of the production of an intermediate additive compound of the hydrocarbon and addendum (*cf.* Holleman, Polak, van der Laan, and Euwes, *Rec. trav. chim.*, 1908, xxvii, 435; Bruner and Dluska, Bull. Acad. Sci., Cracow, 1907, 693; Bancroft, J. Physical Chem., 1908, xii, 417; Cohen, Dawson, Blockey, and Woodmansey, Trans. Chem. Soc., 1910, xcvii, 1623.

[48] H. E. Armstrong, Trans. Chem. Soc., 1887, li, 258.

[49] A. Lapworth, Trans. Chem. Soc., 1898, lxxiii, 454; 1901, lxxix, 1265.

[50] It should be mentioned that other views, based on the loosening or strengthening of the affinity of the hydrogen atoms situated in *ortho-para-* or in *meta-* positions, brought about by the disturbing influence of the radical already present in the molecule on the valency of the carbon atom to which it is attached, and therefore on that of the other five carbon atoms, have been advanced by Flürscheim (J. prakt. Chem., 1902 [ii], lxvi, 321), Tschitschibabin (*ibid.*, 1912 [ii], lxxxvi, 397), and others.

[51] K. J. P. Orton and W. J. Jones, British Association Report, 1910, p. 96; Trans. Chem. Soc., 1909, xcv, 1456.

[52] J. Thiele, *Annalen*, 1899, cccvi, 129.

[53] British Association Report, 1910, p. 96.

[54] *Cf.* W. P. Wynne, art. "Naphthalene," Thorpe's "Dictionary of Applied Chemistry," second edition, vol. 3 (Longmans, 1912).

[55] R. Willstätter and J. Parnas, *Ber.*, 1907, xl, 1406.

[56] N. Bland and J. F. Thorpe, Trans. Chem. Soc., 1912, ci, 871, 1490.

of natural products. The constitution of rubber is approximately known; most of the alkaloids have been explored with a greater or less degree of completeness; and now the study of starch,[57] chlorophyll, and hæmatin (the non-proteid constituent of hæmoglobin)[58] has been taken up afresh during the last three years, with results which, in the case of the two latter, eclipse in importance and interest all that was previously known. In whatever direction we may look, there is the same evidence that we can take to pieces the most complicated structure which nature has devised, and by the aid of valency conceptions can fit the pieces into a formula which is an epitome of the chemical activities of the molecule. Again, in many cases the resources of our laboratories enable us to build up the structure thus displayed, and to establish the identity of nature's product and our own. Nevertheless, the fact remains that all these syntheses leave untouched and unexplained the profound difference between the conditions we find necessary to achieve our purpose and those by which the plant or animal carries on its work in presence of water and at a temperature differing only slightly from the normal. It is, of course, a well-known fact that an enzyme under the appropriate conditions can bring about the same chemical transformation of a substrate as is effected by the living cell from which it can be separated; but our knowledge of these complex, ill-defined, nitrogenous organic compounds is relatively very meagre; they are difficult to purify, and their composition—apart from any question of structure—is largely unknown. Yet because Wöhler chanced to discover that urea can be produced synthetically from an inorganic source the conclusion is not infrequently drawn that all chemical changes in living substance are brought about by ordinary chemical forces.[59] Probably everyone present will concur in that view, but the assent, if given, can scarcely arise from a consideration of the facts, of which there is no great store. Where so little is known accurately, chemistry is not on very safe ground if she infer the rest. What common basis of comparison exists between Wöhler's process and the metabolic changes by which urea is produced in the living body? What evidence have we that because an enzyme and an inorganic agent under different conditions give rise to the same end product, the driving force is the same, although the lines along which it is exercised are very different? I think it is not the least of the many services which Prof. Meldola has rendered to chemistry, that he has given us this warning: "If we have gone so far beyond nature as to make it appear unimportant whether an organic compound is producible by vital chemistry or not, we are running the risk of blockading whole regions of undiscovered modes of chemical action by falling into the belief that known laboratory methods are the equivalents of unknown vital methods."[60]

I turn now to a no less interesting question than that involved in enzyme reactions, namely the wide distribution in plants and animals of single asymmetric substances which if synthesised in the laboratory would be produced as inactive mixtures of both asymmetric forms. It has been argued that the occurrence of racemic compounds in nature, although infrequent, is a proof that in the organism, as *in vitro*, they are in all cases the initial products from which, when separated into antipodes, one of the asymmetric compounds is utilised in the life processes and the other left. But whether this be the case, or whether only the one asymmetric form result from the synthesis, Pasteur firmly held the view that the production of single asymmetric compounds or their isolation from the inactive mixture of the two forms is the prerogative of life. Three methods were devised by Pasteur to effect this isolation, and in only one of them are living organisms—yeasts or moulds—employed; but Prof. Japp, in his address to this Section at Bristol in 1898, emphasised the fact, hitherto overlooked, that in the two others, nevertheless, "a guiding power [is exercised by the operator] which is akin in its results to that of the living organism, and is entirely beyond the reach of the symmetric forces of inorganic nature." Hence, to quote again from his address, "Only the living organism with its asymmetric tissues, or the asymmetric products of the living organism, or the living intelligence—with its conception of asymmetry, can [bring about the isolation of the single asymmetric compound.] Only asymmetry can beget asymmetry." After an exhaustive review of the subject, Japp came to the conclusion that the failure to synthesise single asymmetric compounds without the intervention, either direct or indirect, of life is due to a permanent disability, and although—as was to be expected—this conclusion was challenged,[61] the only "asymmetric syntheses" effected since that time have been operations controlled by the chemical association of an optically active substance with the compound undergoing the synthetical change.[62]

Recently the problem has assumed a more hopeful character. Ostromisslensky[63] in 1908 made the remarkable discovery that inactive asparagine, which is not racemic but a mixture of the *dextro-* and *laevo-*forms in molecular proportion, gave a separation of one or other isomeride when its saturated solution was inoculated by a crystal of glycine—a substance devoid of asymmetry. Now Erlenmeyer claims to have achieved a true asymmetric synthesis by boiling an aqueous solution of inactive asparagine for sixteen hours, when by crystallisation part of the *dextro-*form separated in an almost pure state.[64] The theoretical conclusions which led to this investigation are of much interest because they raise afresh the question whether without displacement of the individual radicals, and apart from antipodes, more than one compound can exist, in the molecule of which two carbon atoms are united by a single linking.[65] As an illustration, reference may be made to the malic-acid series, in which three optically active compounds are known, the *dextro-*acid, the *laevo-*acid, and Aberson's acid.[66] In the *laevo-*series the three isomerides obtainable by rotation of one of the carbon atoms with its attached radicals relatively to the other would be

[57] H. Pringsheim and H. Langhans, *Ber* 1912, xlv, 2533.

[58] For summaries of Willstätter's and Marchlewski's researches on chlorophyll, and of Piloty's on hæmatin, *cf.* "Annual Reports on the Progress of Chemistry (Gurney and Jackson) 1911, viii, 144–152; 1912, ix, 165–172.

[59] "Quite similar changes can be produced outside the body (*in vitro*) by the employment of methods of a purely physical and chemical nature. It is true that we are not yet familiar with all the intermediate stages of transformation of the materials which are taken in by the living body into the materials which are given out from it. But since the initial processes and the final results are the same as they would be on the assumption that the changes are brought about in conformity with the known laws of chemistry and physics, we may fairly conclude that all changes in living substance are brought about by ordinary chemical and physical forces."—Sir Edward Schäfer, President's Address at the Dundee Meeting, British Association Report, 1912, p. 9.

[60] R. Meldola, "The Chemical Synthesis of Vital Products" (Arnold, 1904), p. 7.

[61] F. R. Japp, "Stereochemistry and Vitalism. Presidential Address to Section B (Bristol), British Association Report, 1898, p. 826; *cf.* K. Pearson, NATURE, 1898, lviii, 495; G. Errara; F. R. Japp, *ibid.*, 616; Ulpiani and Condelli, *Gazz. chim. ital.* 1900, xxx [i], 344; Byk, *Ber.*, 1904, xxxvii, 4696; Heule and Haakh, *Ber.*, 1908, xli, 4261; Byk, *Ber.*, 1909, xlii, 141.

[62] *Cf. inter alia*, McKenzie, Trans. Chem. Soc., 1905, lxxxvii, 1373.

[63] I. von Ostromisslensky, *Ber.*, 1908, xli, 3035.

[64] E Erlenmeyer, Biochem Zeitsch, 1913, lii, 439.

[65] *Cf.* J. Wislicenus, "Ueber die räumliche Anordnung der Atome in organischen Molekülen" (Leipzig bei S. Hirkel, 1889), 28; K. Auwers and V. Meyer, *Ber.*, 1888, xxi, 791.

[66] J. H. Aberson, *Ber.*, 1898, xxxi, 1432; P. Walden, *Ber.*, 1899, 32, 2720.

H	H	H
OH . C . CO_2H	OH . C . CO_2H	OH . C . CO_2H
CO_2H . C . H	H . C . CO_2H	H . C . H
H	H	CO_2H
laevo-acid, $[a]_D - 5.8°$	(not isolated)	(Aberson's acid, $[a]_D + 9.8°$

With the inactive asparagine it is supposed by Erlenmeyer that prolonged heating in aqueous solution produces a rotation of this type, possibly to an unequal extent or in opposite directions in the *dextro-* and *laevo*-forms, whereby the products being no longer antipodes become separable by ordinary laboratory methods. It is too early yet to say whether, by exclusion of all asymmetric influences, the riddle has been solved, but it is easy to understand with what interest confirmation of Erlenmeyer's results is awaited.

Honours Students and Post-Graduate Scholarships.

In bringing this address to a conclusion, it will not be an innovation if I refer—it shall be only briefly—to the training of those who will carry on and amplify the work which we in this generation have attempted to do. This section stands for the advancement of chemistry which includes, so closely are pure and applied chemistry intertwined, the advancement of chemistry as applied to industry. Once again the cry has been raised in the Press[67] that chemists trained in our universities are of little value in industrial pursuits; they are too academic; they are not worth their wage—little as that often is, whether judged by a labourer's hire or the cost of a university training. It may be so. On the other hand, it is possible the employer obtains all that he pays for, and by paying more would receive in return much more by the inducement offered to more highly trained men to enter the field. Three years' training for the ordinary degree cannot carry a student very far in chemistry, and this preliminary training—for it is little more—is insufficient to equip the young graduate for more than routine work. With the honours student it is otherwise. He must either enter on his three years' residence at a university with a knowledge which does not fall below the requirements of the intermediate examination, and devote the greater part of his time to his honours subject, or he must be prepared to spend a fourth year to reach the necessary standard. More highly equipped in the academic sense than a man who has worked only for the ordinary degree, he undoubtedly is, yet there is seldom time to begin his training in research methods or in methods of commercial analysis where rapidity rather than extreme accuracy is the object in view.

Two reforms, I venture to think, are needed: the first would avoid early specialisation, which is apt to be disastrous, the second would encourage post-graduate training in directions where the student's inclinations or aptitude may be stimulated and developed. If the civic universities, established in virtue of charters drafted mainly on similar lines and inspired by similar aims, could come to some agreement requiring three years' residence, subsequent to the intermediate, for an honours degree in chemistry, the first reform would be effected—it is a measure for which a strong case can be made out. If, further, they could see their way to standardise their ordinances and regulations for the M.Sc. degree, cease to confer it on honours graduates of one or more years' seniority in return for payment of a fee, and confine it to graduates—not necessarily honours graduates—who have carried out an approved piece of research during not less than one academic year, selection committees, boards of directors, or individual employers would have some clue to the type of man before them. I would go further and suggest that the interchange of honours graduates between the civic universities, or between them and other universities or colleges, if it could be arranged, would be of much benefit to the student himself. No university in this country is wealthy enough to attract to its service teachers who are pre-eminent in each branch of chemistry. How great, then, would be the gain to an honours graduate working for the M.Sc. degree, if, instead of being associated with the same teacher during the whole of his academic career, he could migrate from the place which had trained him to spend part, or the whole, of his time in the laboratory of an Armstrong, a Donnan, a Perkin, or a Ramsay, during that most critical period when he is sorting out his own ideas and learning how to use his fingers and his wits. But whether enforcement of the longer training for the honours degree be possible; whether a research degree as a step to the doctorate be desirable or practicable, there can be no doubt that the urgent need of the present time is the provision of scholarships and exhibitions, sufficient in value to secure at least a bare livelihood, for post-graduate work. He who is able to convert education committees and private donors to the view that a far better return for the money could be assured if part of the large expenditure on scholarships for matriculated or non-matriculated students were diverted to post-graduate purposes, will have done a service to science and the State the value of which, in my opinion, cannot be overestimated.

[67] Cf. *The Times*, Engineering Suppl., 1913, May 7, 21, 28, June 4, 11, 18.

NOTES.

WE announce, with deep regret, the death, on Thursday last, of Sir Walter Noel Hartley, F.R.S., formerly professor of chemistry at the Royal College of Science, Dublin. He was in the sixty-eighth year of his age.

PROF. ARMINIUS VAMBÉRY, the Oriental scholar, died at Budapest on September 14, in his eighty-second year. The obituary article on him in *The Times* states that in 1851 the sum of 1000 florins was voted to him by the Hungarian Academy of Sciences on condition that he went into the interior of Asia to investigate the affinities of the Magyar tongue. In the following year he left for Persia, joining a caravan of Tartar pilgrims returning from Mecca. In no way intimidated by predictions of privations and dangers or by the melancholy fate of Conolly, Stoddart, Moorcroft, and others, he decided to maintain throughout the journey a strict disguise as a dervish. Leaving Teheran on March 28, 1863, Vambéry reached Khiva at the end of May, after intense sufferings from thirst in the trackless desert. In 1864 he visited London, gave an account of his travels at a meeting of the Royal Geographical Society, and did his best to convince public men in England of the necessity for the creation of a neutral zone or a geographical buffer State in Central Asia.

THE death is announced at Chatham, Ontario, of Dr. Alex. MacFarlane, in his sixty-third year. A native of Blairgowrie, he graduated at Edinburgh in

1875, after a brilliant University career. The thesis by which he obtained the doctorate in 1878 was a remarkable experimental research into the conditions governing the electric spark. This brought him under the notice of Clerk Maxwell. In the same year he was elected F.R.S. Edinb. In 1885 Dr. MacFarlane was appointed to the chair of physics in the University of Texas. About fifteen years ago he took up his residence in Canada, where he continued to be actively engaged in physical and mathematical research. The latest of his many publications was a "Bibliography of Quaternions," issued in 1904.

ONE of the passengers killed in the disastrous New Haven Railway collision, which occurred on the same day as that at Aisgill, was Dr. Joseph Benson Marvin, professor of medicine and neurology at the University of Louisville. Dr. Marvin was born in Florida in 1852. At the age of eighteen he was appointed assistant professor of chemistry and physics at the Virginia Medical Institute. He then took a medical course, and afterwards held professorial posts at the Louisville Hospital College of Medicine, the Kentucky School of Medicine, and Kentucky University successively. Dr. Marvin's wife and daughter, who had been with him on a holiday in Maine, were also victims of the disaster.

CHANGES in the staff of the Central Research Institute at Kasauli are announced. Major W. F. Harvey, I.M.S., is taking the place of Sir David Semple as head of the institute, and Capt. J. W. McCoy, I.M.S., is to join the bacteriological department.

A BOARD for the study of tropical diseases has been established at Ponce, Porto Rico, by the Medical Department of the United States Army. The first president of the board is to be Major B. K. Ashford.

ACCORDING to *The Times*, arrangements are being made for an expedition to King Edward the Seventh's Land, in the south polar region, to start in August next. The leader is to be Mr. J. Foster Stackhouse, who was associated with Capt. Scott in organising the voyage of the *Terra Nova*. The present arrangements are that the members of the expedition shall sail from the Thames about the middle of August in the steam yacht *Polaris*, a ship especially built for ice navigation in accordance with designs approved by an international committee of explorers, including Charcot, de Gerlache, and Nansen. It is contemplated that the expedition will be absent for twenty months or more.

PARTICULARS of the plans of the Italian expedition to the Himalayas, which is to be led by Dr. Filippi are given in *The Pioneer Mail*. According to our contemporary the explorers will work in Karakoram throughout the summer of 1914, spend the autumn in Chinese Turkestan, and leave for Europe by about Christmas. It is the object of the leader to carry out observations across Chinese Turkestan into Russian Turkistan, to winter in Scardo in Baltistan, and early in the spring of 1914 to travel by the inner Indus valley to Leh. From the latter place the expedition will leave for the Karakoram district to survey and map the unknown portion of the Karakoram range which lies between the Karakoram pass and the Siachen glacier. The Government of India, which has subscribed 1000*l*. towards the funds, has appointed Major Woods, of the Trigonometrical Survey, to accompany the expedition.

AMONG the communications to be made at the forthcoming meeting of German Naturalists and Medical Practitioners, at Vienna (September 21–28), we notice the following:—An address by Prof. von Behring on the prophylaxis of diphtheria, and papers on the development of the light and colour senses in the animal kingdom, vision, and the problem of race crossing in man by, respectively, Profs. von Hess, O. Lummer, and E. Fischer.

THE seventeenth annual fungus foray of the British Mycological Society, lasting a week, is to begin at Haslemere on September 22. The meeting place of the party will be the Hutchinson Museum. On September 24 the presidential address will be delivered by Mr. A. D. Cotton, who will take as his subject, "Some Suggestions as to the Study and Critical Revision of Certain Genera of Agaricaceæ." On the following day a paper, entitled "Recent Work on Resupinate Theleshoreæ," will be read by Miss E. M. Wakefield, and on September 26 Mr. J. Ramsbottom will read a paper entitled "Some Notes on the History of the Classification of the Discomycetes."

THE twenty-fourth annual general meeting of the Institution of Mining Engineers is to take place at Manchester on September 24–26, when the following papers will be read, or taken as read:—"A Method of Measuring Goaf Temperatures," T. F. Winmill; "The Absorption of Oxygen by Coal," T. F. Winmill; "Dust Problems in Mines and their Solution," Hermann Belger and A. Owen Jones; "Further Researches in the Microscopical Examination of Coal, especially in Relation to Spontaneous Combustion," James Lomax. In addition to the foregoing, the following papers, which have already appeared in the Transactions, will be open for discussion:—"Recent Methods of the Application of Stone-dust in Mines," Dr. W. E. Garforth; "The Reopening of Norton Colliery with Self-contained Breathing-apparatus after an Explosion," J. R. L. Allott; "The Slow Oxidation of Coal-dust and its Thermal Value," F. E. E. Lamplough and A. Muriel Hill; "Insulated and Bare Copper and Aluminium Cables for the Transmission of Electrical Energy, with Special Reference to Mining Work," B. Welbourn. In connection with the meeting a lecture on explosion experiments at Eskmeals will be given on September 25 by Prof. H. B. Dixon, F.R.S.

WE understand that the title of Prof. W. Ostwald's journal, *Annalen der Naturphilosophie*, has been changed to the more comprehensive one of *Annalen der Natur- und Kulturphilosophie*; also that Prof. R. Goldscheid is now associated with Prof. Ostwald in editing the periodical.

THE correspondent of *The Times* at Rome reports an interesting discovery made by Mr. Adolfo Cozza in excavating at Pompeii with the object of tracing the site of the port where, in his opinion, three-fourths of the population sought escape from the eruption of Mount Vesuvius, hoping that the Roman fleet would be able to remove them into safety. After various try-pits had been sunk he discovered plaster and concrete, and finally a road leading to the sea showing signs of the passage of wheels. The masonry-work of a harbour was then unearthed with the marks left by the waves. The port which has just been discovered is at a distance of about 1300 yards from the existing seashore and about 700 yards from the ruined city. It is covered with a layer about 23 ft. deep, consisting of earth, lava, ashes, and *lapilli*. Further excavations will, it is thought, bring to light the skeletons of the majority of the population of Pompeii as well as treasures of gold and works of art.

A LARGE Etruscan necropolis, containing several skeletons, as well as vases and terra-cottas, dating from the seventh century B.C., has been discovered near Civita Vecchia in Italy, on the coast of Latium.

A CURIOUS story comes from Ireland that Mr. E. S. Dodgson, of Jesus College, Oxford, has discovered at Killult, Falcurragh, Donegal, a stone said to contain an Ogham inscription giving a clue to a great treasure concealed in the neighbourhood by an ancient Irish chieftain. The stone is being examined by Mr. R. Macalister. We wish the discoverer success in unearthing the treasure, but until he succeeds, or some other interpretation of the supposed inscription is suggested, it may be well to reserve opinion on the matter.

A RECENT message from San Francisco stated that the Falcon and Hope Islands of the Tonga group had disappeared. The information was brought by Capt. Trask of the steamship *Sonoma*, from Sydney, who is reported to have said :—"One of the regular trading steamships between Sydney and the Tonga group reported the sinking of the islands. The vessel steamed to where Falcon Island should have been, but it was nowhere in sight. Just before this the instruments at Sydney naval station showed that several violent earthquake shocks had taken place about 2000 miles north-east of Sydney." With reference to the foregoing message, Mr. Basil A. Thomson (who acted for a time as Prime Minister of Tonga), wrote to *The Times* on September 14 that the news should be received with reserve for the reasons, "first, that Falcon had already ceased to exist as an island fourteen years ago; and, second, that Hope Island, better known by its native name of Niuafo'ou ('New Niua'), is reported to have disappeared whenever a serious volcanic disturbance shakes the nerves of the white residents of Tongatabu."

THE Museum Journal of the University of Pennsylvania announces in its March issue the despatch of an expedition, under charge of Dr. Farabee, to explore the primitive tribes of the Amazon forests. The Brazilian Government promises active assistance to Dr. Farabee and his staff. From Para they will proceed to Manaos, and from thence ascend the Rio Negro, the largest tributary of the Amazon from the north-west. The examination of this region will occupy the attention of the expedition for six months or perhaps a year. The collections to be made will consist of weapons, utensils, and all objects relating to the arts of life procurable among the various tribes to be visited. They are destined to supply material for future research, and especially to enable the museum to reproduce the actual life of some of the most interesting native tribes, soon destined to disappear.

IN No. 2, vol. xxiv., of *Folk-lore* we have the final, but unhappily fragmentary, dissertation by the late Mr. Andrew Lang, in which he develops his theory of the origin of exogamy and totemism. Following Darwin, he assigns the beginnings of exogamy to the expulsion by the sires of the group of the younger males. He assumes that the establishment of totemic groups and practices cannot have been sudden; men cannot have, all in a moment, conceived that each group possessed a protective and sacred animal or other object. But if each group woke to the consciousness that it bore the name of a plant or animal, and did not know how it came to bear that name, no more was needed to establish a belief in the essential and valuable connection of the group with certain animals, birds, or other objects. These names, he thinks, originated in sobriquets given by one group to another. In this exposition he is in general agreement with the views of Dr. A. C. Haddon in his address delivered before the British Association at the Belfast meeting in 1902.

IN *Man* for September Mr. W. J. Lewis Abbott describes a collection of pygmy flint implements made by Mr. J. M. Bain from the base of the sand-dunes at Fishook, Cape Colony. They closely resemble the series presented by Miss Nina Layard to the Ipswich Museum. Mr. Abbott believes that this is the result of culture-transmission. "It is obvious," he believes, "that the prototypes of these shapes could not have arisen in a country where the native material did not lend itself to their manufacture; but in one where a homogeneous silica, such as flint, was the common indigenous material; and in following up the search for these interesting little objects, we shall be getting together the material to show the migrations of this old race over the face of the earth, and perhaps be able to trace it to its cradle."

IN the Philadelphia Museum Journal for June Dr. Arno Poebel, of Johns Hopkins University, announces an important discovery among the collection of clay tablets obtained at Nippur during the years 1888–1900, which are now being arranged for exhibition. One tablet, unfortunately imperfect, gives a version of the Creation story, in which the origin of the first human beings is attributed to the gods Enlil and Enki, and the goddess Ninharsagga—a question which has led to much speculation among Assyrian and biblical scholars. In the present version, when Enlil, the creator of heaven and earth, wished to people the world with human beings, the god Enki, the deity of wisdom and knowledge, devised the image of man after the image of the gods, and the goddess Ninharsagga moulded it in clay, while the blood of Enlil gave it life and intellect. Whether the idea that Enlil cut off his head will be corroborated from other cuneiform sources we cannot tell at present. Meanwhile the present discovery is obviously of the highest importance.

In the May number of *The Irish Naturalist* (vol. xxii., No. 5), Mr. N. Colgan gives an interesting account of the renascence flora of certain areas on Killiney Hill, Co. Dublin, formerly covered with old gorse but burnt out in July, 1911. Three months after the fire the burnt areas showed thirteen species of flowering plants, partly survivals from old root-stocks, partly immigrants from adjacent unburnt areas, and partly perhaps the product of seeds that had retained their vitality throughout the fire. Later observations showed that eighteen months after the fire a renascence flora of sixty-four species, including nine cryptogams, had taken possession of the areas burnt clear of all vegetation. Of these species, forty-five had certainly or very probably entered from adjacent unburnt areas, thirteen were survivals, and the remaining six could not with certainty be placed among either immigrants or survivals, and are classed as of doubtful origin. The cryptogams covered much more ground than the flowering plants, the most abundant species, dominating above all other plants in the burnt ground flora, were the mosses *Funaria hygrometrica* and *Barbula fallax*; other common bryophytes were three species of Polytrichum and the liverwort *Marchantia polymorpha*; while two species of the lichen genus Parmelia were also frequently found. Among the phanerogamic immigrants the grasses were strongly predominant, and the immigrant flora as a whole consisted largely of plants provided with special adaptations for seed dispersal, one of the most prominent of these plants being *Senecio sylvaticus*. The most interesting fact arising from this new flora is the conflict between its higher and lower members, the phanerogams and the cryptogams, the latter having so far kept in check the much more varied phanerogamic flora. The probable successive changes in the vegetation are outlined by the author.

We have received a reprint of an interesting paper by Dr. C. B. Crampton, "The Use of Geology to the Forester" (*Trans. Argyll Foresters and Gardeners*, 1912), pointing out some of the geological facts that have a bearing upon the nature and origin of the various types of surface occupied by plants, and emphasising the importance to foresters in particular of a knowledge of the nature of the ground under his charge in so far as it reacts with the vegetation, and the reasons for differences in the surface and in these reactions. The author indicates the geographical and geological factors upon which depends the nature of a habitat for trees or other plants, with special reference to the action of gravity in screes and landslips, the erosive action of wind and streams, coastal erosion, glacial erosion and deposition, and the characters of soils and subsoils.

In a recent number of *The Herts Advertiser* it is stated that, in consequence of Dr. Sambon's remarks on pellagra at a recent meeting of the British Medical Association, Dr. Blandy, of the Lunatic Asylum at Napsbury, near St. Albans, undertook an examination of the patients in that institution, with the result that no fewer than eleven were found to be suffering from that disease. As the majority of these come from the moist, low-lying district of the Colne Valley, support is afforded to the opinion that the disease is propagated by insects.

As a result of the examination of the large series of specimens of mammals and birds collected in East Africa by the Roosevelt and other American expeditions, very considerable additions have been made recently to the list of species and races from that area, the descriptions having been published for the most part in various issues of the Smithsonian Miscellaneous Collections. The latest of these papers include one by Mr. E. Heller (vol. lxi., No. 7), on new races of antelopes, and another, by Mr. E. A. Mearns (*ibid.*, No. 9) on new weaver-birds. As regards the antelopes, it must suffice to mention that some of the new races are founded on very slight differences from previously known forms, and it is thus rendered difficult to see where the modern fashion for excessive splitting is to stop.

In connection with the preceding paragraph, it may be mentioned that in the current issue of the Zoological Society's Proceedings three additions are made by Messrs. Barrett-Hamilton and Hinton to the British mammal-fauna, all three being from the Inner Hebrides. The most interesting of these is a shrew-mouse (*Sorex granti*), distinguishable at a glance from the common English *S. araneus* by the contrast presented by the light-coloured flanks to the dusky upper parts. As it also exhibits certain dental peculiarities, its right to specific rank seems undoubted. The other are field-mice; one (*Evotomys alstoni*) a species from Mull, and the other (*Microtus agrestis macgillivraii*) a race from Islay.

The September number of *The Museums Journal* contains an illustrated account of Mr. J. A. C. Dean's method of "showing" objects in museums and art galleries to blind persons, as explained at the Hull meeting of the Museums Association. The method appears to have attained considerable success, and to have awakened a new interest in the class for which it is intended. It may be remarked—as indeed was hinted by the president at the close of the discussion—that if this mode of demonstration is adopted in up-to-date zoological museums it will be necessary for each to have a separate series of stuffed specimens for this purpose.

In the *Verhandlungen der Naturforschenden Gesellschaft in Basel* (Bd. xxiv.) will be found a paper by the late Fr. Burckhardt, entitled "Die Stellung des Osterfestes im christlichen Kalender." It is a contribution to the historical side of the question, and contains several original documents of some interest. An extract from the writings of Luther is given, in which he advocates a fixed date for Easter, not merely without regard to the moon's phases, but also, like Christmas, without regard to the days of the week. Other documents refer to the adoption of the reformed calendar by the Protestants in Switzerland. Practical convenience forced them to follow the Gregorian calendar in the main, though not until the end of the seventeenth century, and even then one difference was maintained. This arose from basing the calculation of the Easter full moon on the Rudolfine Tables instead of the Gregorian Epact. The first discrepancy occurred in the year 1724, when the Gregorian full moon fell on Sunday, April 9, while the Tables gave the day preceding. The question was referred for decision to the Protestant Conference at Ratisbon early in 1723, and the Basel authorities sought the advice of John Bernoulli. The replies are reproduced in full. In the result Easter was celebrated by Catholics and Protestants on successive Sundays in 1724 and again in 1744. Agreement was finally brought about by an order of Frederic the Great in 1776 on the basis of the Gregorian calendar. The desirability of a fixed Easter has been commonly felt from the time of the Gregorian reform, and it was the last act of Father Denza, late director of the Vatican Observatory, to prepare a memorandum on the subject for Pope Leo XIII. His proposal was to adopt the third Sunday following the vernal equinox, which would limit Easter between April 4 and 11.

THE Director-General of Observatories (India) has issued a memorandum dated August 9 on the monsoon conditions prevailing during June and July, with anticipations for August and September. From the recent data regarding the conditions most likely to be of influence, and which are stated in detail, the unfavourable factors appear to predominate slightly. But the inferences drawn are (*a*) that the total rainfall of the months in question will probably be normal or in slight defect, (*b*) that in north-west India the monsoon is not likely to be affected prejudicially by snowfall. (The fall of temperature and dry north-westerly winds that usually follow widespread and heavy snowfall have not been experienced.) The above forecast agrees practically with that issued on June 8 (NATURE, August 7).

DR. NILS EKHOLM has contributed an important article on the weather in the North Sea during the first half of June, 1911, illustrated by synoptic charts, to No. 64 of the Occasional Publications issued under the authority of the International Council for the Study of the Sea. The period is chosen because the council had then six hydrographical expeditions stationed in that sea. The author prefaces his inquiry by a careful historical summary of the development of meteorology and its methods from the invention of the barometer to the present time, and with a description of barometric changes and their relation to wind and weather, in which we were pleased to see that the valuable pioneer work of Admiral FitzRoy, the first chief of the Meteorological Office, is duly recognised. The author explains that the difficulties with which modern conceptions of cyclones and anticyclones have to contend led him to supplement the usual isobaric charts by plotting the ± differences of barometric readings since the last observation, and thus constructing "isallobars," or lines of equal differences. He remarks, *inter alia*, that a close study of the movements of the isallobars shows that pressure changes are the primary, and cyclonic and anticyclonic whirls the secondary phenomena. The charts for the North Sea for the above period and two other cases are discussed upon those principles.

DR. H. GEIGER, of the Reichsanstalt, who four years ago, in conjunction with Prof. Rutherford, devised a method of counting the number of α particles emitted by a radio-active body, has now, according to a communication from the Reichsanstalt, succeeded in perfecting a very simple method which allows both the α and β particles to be counted. The α or β rays are allowed to enter a short metal cylinder 2 cm. diameter, by a small hole in the base. Through an ebonite block which closes the other end of the cylinder a sharp pointed rod projects into the cylinder to within 0·8 cm. of the base. The cylinder is raised to about 1200 volts, and the pointed rod is connected to a string electrometer provided with a high-resistance leak. The entry of either an α or a β particle into the cylinder causes a spark to pass between point and cylinder, and the electrometer of 10 cm. capacity acquires a charge corresponding to 10–20 volts. The throws of the electrometer are recorded photographically, and the results obtained are in agreement with those calculated from ionisation observations in the case of the polonium preparation used in the observations.

Engineering for September 5 contains an illustrated account of the Sulzer-Diesel locomotive built by Messrs. Sulzer Brothers at Winterthur, in the early part of this year, and supplied to the Prusso-Hessian State Railway, Berlin. This is the first locomotive fitted with Diesel engines, and is designed for fast traffic. The length over-all is 54·5 ft., and the weight in working order is 95 tons. The main engines are of the reversible two-cycle type, single-acting, having two pairs of cylinders inclined at 90° to each other. The pistons are 15 in. diameter by 21·7 in. stroke. Running at 304 revolutions per minute, a speed of sixty-two miles per hour is obtained. The auxiliary machinery required is of a somewhat complicated character. Trials have been made, and show that the engine is adaptable to a wide range of work. It is reported that the change from air to oil-fuel is accomplished without trouble at a speed of about six miles per hour, and that the reversing arrangements were equally successful.

Engineering of the same date has an article dealing with problems of the internal-combustion locomotive, in which further reference is made to the Sulzer-Diesel locomotive. Our contemporary considers that any locomotive engineer reading the full description of this engine would be somewhat appalled at the extraordinary amount of machinery the type involves. The main engine requires another engine, of one-quarter or one-fifth of its power, to make it start at all. The second engine, also of Diesel type, requires similar provision in the way of air and circulating-water supply, &c., to the main engines, involving pumps for the supply of starting air, scavenging air, injection air, fuel to each cylinder, jacket water, circulating water for pistons, and for lubrication of bearings, &c. A comparison of this collection of machinery with that in a modern steam locomotive is greatly in favour of the latter. Neither does the Diesel locomotive appear to show up any too well as a power plant; one horse-power is developed for about 190 lb. weight. A modern steam locomotive develops one horse-power for about 100 lb. of engine weight, or for every 140 to 150 lb. of combined engine and tender weight. Rapid perfecting of this type of engine is not to be expected, but it is to be hoped that the efforts instituted on the Continent will be persisted in. The greater the initial handicap, the more glorious the ultimate victory.

Attention may be directed to a slight error in the date assigned to Messrs. Cartailhac and Breuil's monograph on "La Caverne d'Altamira"; the frontispiece bears the date 1906, but this work was not published until 1908.

OUR ASTRONOMICAL COLUMN.

The Rotating Ellipsoid RU Camelopardalis.—The elaborate investigations recently carried out by Prof. H. N. Russell upon the treatment of photometric observations of variable stars have been the means of bringing to light a new class of these bodies. By taking into account the hypothetical, but, of course, quite possible ellipticity of the components of a binary system, a method was developed which may be applied equally well to the case of an isolated rotating ellipsoid—an early stage in the development of a binary system. At Princeton during the last two years the light changes of three stars—S Antliæ, SZ Tauri, and RU Camelopardalis—have been explained in the most satisfactory way on the hypothesis that they are rotating ellipsoids. In Bulletin No. 21 of the Laws Observatory Mr. Harlow Shapley discusses 292 photometric measures of the third of these stars, and comes to the conclusion that "the light variations . . . can be satisfactorily accounted for on the hypothesis of a single, uniformly luminous, ellipsoidal body rotating in a period of 44·344 days." With regard to the spectrum of this star the author quotes a letter from Prof. E. C. Pickering to the effect that it is peculiar and apparently variable, and that Miss Cannon thinks it may belong to class N.

The publication of the curves and results for S Antliæ and SZ Tauri is promised for the near future. As both these stars have spectra of classes much less prone to variability of a physical character the realisation of this promise will be awaited with great interest.

The Diminution of the Solar Radiation in 1912.—Further evidence regarding the existence of a widespread atmospheric opacity during 1912 appears in a note by M. Ladislas Gorczynski in the *Comptes rendus* (vol. clvii., No. 1). The pyrheliometer record made at Varsovie shows that during the latter half of the year there was a marked falling off in the intensity of the solar radiation. The detailed measures, we are informed, show that the depression lasted from about the middle of June, 1912, to the middle of January, 1913, and was most severe in September. Similar results were obtained at the Meteorological Observatory of Olczedajów, and it is pointed out that analogous records were obtained at Mount Weather.

Comet 1913*b* (Metcalf).—A supplement to *Astronomische Nachrichten*, No. 4679, contains a continuation of the ephemeris of this comet which was given last week, after the first approximate elements computed by Prof. Kobold. The comet is slowly increasing in brightness, according to the ephemeris, but on September 3 it was observed as of magnitude 9·5, and on September 4 as of magnitude 10·0.

12h. M.T. Berlin.

	R.A. h. m. s.	Dec. ° ′	Mag.
Sept. 18	6 6 18	+67 23·5	—
19	6 0 47	68 8·6	10·3
20	5 54 43	68 54·0	—
21	5 47 58	69 39·4	—
22	5 40 26	70 24·3	—
23	5 32 2	71 8·8	10·3
24	5 22 42	71 52·9	—

Comet 1913*c* (Neujmin).—This comet when first observed (September 3) was thought to be a minor planet, but later observation has suggested its cometary nature. Herr M. Ebell has computed the elements from the observations of September 6, 7, and 8, and these, with an ephemeris, have been communicated in a Kiel circular. They are as follows:—

$$T = 1913 \text{ July } 22.5755 \text{ M. T. Berlin.}$$

$$\left.\begin{aligned}\omega &= 320^\circ\ 56{\cdot}70'\\ \Omega &= 347^\circ\ 19{\cdot}42'\\ i &= 12^\circ\ 22{\cdot}97'\end{aligned}\right\}1913{\cdot}0.$$

$$\log q = 0{\cdot}11296$$

Ephemeris for 12h. M.T. Berlin.

	R.A. h. m. s.	Dec. ° ′	Mag.
Sept. 18	22 43 10	+4 9·3	—
19	22 42 40	4 27·7	—
20	22 42 10	4 45·5	11·2

According to Dr. Graff, at Bergedorf, the comet showed a short tail on September 6, but on September 8, from observations made at Pulkova, the object was recorded as stellar.

New Laboratory Spectroscopic Results.—The physical laboratory of the Imperial College of Science and Technology is responsible for four different spectroscopic researches recently communicated to the Proceedings of the Royal Society (Ser. A., vol. lxxxix., pp. 125–149). Mr. L. C. Martin, a research student, writes on a band spectrum attributed to carbon monosulphide, and has found a new spectrum consisting of a number of bands degraded to the less refrangible side, the wave-lengths of which he gives in his paper. Prof. Fowler records new series of lines in the spark spectrum of magnesium incidentally tying up the well-known spark line at λ4481 in one of the series. In conjunction with Mr. W. H. Reynolds, research student, Prof. Fowler has another paper on additional triplets and other series lines in the spectrum of magnesium. Eight additional triplets have been measured in the spectrum of magnesium arc *in vacuo*, six belonging to the diffuse and two to the sharp series. Four additional members of the Rydberg series of single lines have been photographed, and four strong solar lines of unknown origin have been identified with lines of the Rydberg series. Two known lines, 5711·31 and 4730·21, have been coupled up in a series with 4354·53, a previously unrecorded line. Mr. W. E. Curtis, the demonstrator of astrophysics, has a paper on a new band spectrum associated with helium, but the question of its origin is still doubtful, as hydrogen was present in all the tubes examined. A list is given of the wave-lengths determined. A search in celestial spectra was made, owing to its association with helium, but the result was negative.

The Perth Observatory Section of the Astrographic Chart.—Vols. ii. and iii. of the Perth Observatory (Western Australia) section of the astrographic chart have just come to hand. These volumes are two out of the thirty-six volumes which will be published. The region of the sky assigned to this observatory lies between 31° and 41° S. declination, and the photographs have been taken and measured under the direction of Mr. W. Ernest Caske, the Government Astronomer for Western Australia. Vol. ii. contains the measures of rectangular co-ordinates and magnitudes of 20,211 star images, R.A. 6h. to 12h., on plates with centres in declination −32°, and vol. iii. those of 20,988 images, R.A. 12h. to 18h., on plates with centres also in declination −32°.

The completed work will be a valuable contribution to the great international scheme, initiated so many years ago. Incidentally a number of double stars were met with during the measurement of the zone plates, and these, 242 in number, have been collected and published in a separate catalogue, forming Bulletin No. 1. The reduction of the measures was undertaken by Mr. Nossiter, acting first assistant.

The Extension of the Zone Time System.—Brazil has now officially fallen into line by adopting standard time. The country has been divided into four zones, and the legal time for each respectively will be two, three, four, and five hours slow on Greenwich. The islands of Trinidad and Fernando Noronha fall in the first zone. The western side of the second zone is a line from Mount Pecuary Grevaux, on the French Guiana boundary, by the rivers Pecuary and Javary to the Amazon, and by Xinsu to the Matto-Grasso boundary. The fourth zone includes the western part of Amazonas, the Acre territory, and other territory recently ceded by Bolivia.

Hind's Nebula.—M. Borrelly has communicated to the Academie des Sciences (*Comptes rendus*, vol. clvii., No. 7) a brief note stating that the nebula discovered by Hind in the year 1845 (No. 6760 in Dreyer's N.G.C.) and suspected of variability of brightness seven years later by d'Arrest, now appears to be in a period of maximum. For the first time since 1867 it is easily seen with a comet-seeker of 6½ in. aperture.

The Royal Observatory, Cape of Good Hope.—The annual report of his Majesty's Astronomer at the Cape of Good Hope for the year 1912 has been received. In connection with the reduction of the circumpolar observations made in the previous year some interesting determinations of personality have been made. It appears that, while with the older methods of observing, transits of equatorial stars are mostly recorded *late*, transits of slow-moving circumpolars are *anticipated* by 0·3s. The astrophysical work has been actively advanced, both in the observatory and laboratory. Provisional spectroscopic determinations of solar parallax and the constant of aberration, based as the measures of 800 plates, yielded 8·802″±0·004″ as the value of the former, and 20·47″±0·01″ for the latter. In the laboratory it has been found more convenient to employ the spark spectrum obtained from the cores of lead pencils as a comparison spectrum in preference to the spectra of iron or titanium.

A CURIOUS METEORIC DISPLAY.

The universal disappointment experienced by keen meteor observers on the expected return of the November Leonid meteor swarm in 1899, the swarm which created such a stir of excitement at its appearance in the year 1866, is no doubt responsible for the apparent lack of interest taken in the announcements of probable meteoric displays to-day. Many of us thought that this celebrated display, due possibly to planetary perturbations, might be accelerated, and so were careful to keep a good look-out in the appointed month in 1897 and 1898, and their non-appearance in 1899 suggested that possibly, for a similar reason, the swarm might have been belated, and so watched at the correct season for the overdue display. The expected event did not take place, and faith was lost in the predicted times of these space wanderers.

Our interest is, however, again wakened by what is described as "an extraordinary meteoric display" which was seen over a very extensive area in the United States of America and Canada on the evening of February 9 this year. The magnitude of the display was such that a very great number of people distributed in the path of observation had their attention drawn to it, and its peculiar nature was so marked that nearly every observer remarked similarly of the extraordinary feature of the event.

Fortunately Prof. C. A. Chant, of Toronto, although not an eye-witness of the phenomenon, undertook to collect all the available information of this very exceptional, if not unique, occurrence. In the May–June number of the *Journal* of the Royal Astronomical Society of Canada he presents a very judicious summary of the observations made, and accompanies this with extracts from letters received from observers.

The sum total of the discussion of the data is to show that the apparition took the following form:—

As seen from western Ontario there suddenly appeared in the north-western sky a fiery red or golden-yellow body, which quickly grew larger as it approached, and had attached to it a long tail; observers vary in their descriptions as to whether the body was single or composed of three or four parts with a tail to each part.

This body or group of bodies moved forward on an apparently perfectly horizontal path "with peculiar, majestic, dignified deliberation; and continuing its course without the least apparent sinking towards the earth, it moved on to the south-east, where it simply disappeared in the distance." After this group of bodies had vanished, another group emerged from precisely the same region. "Onward they moved, at the same deliberate pace, in twos or threes or fours, with tails streaming behind them, though not so long or bright as in the first case." This group disappeared in the same direction. A third group followed with less luminosity and shorter tails.

In reading some of the communications from the numerous observers, the extraordinary feature of the phenomenon seems to have been the regular order and movement of the groups. Thus some compared them to a fleet of airships with lights on either side and fore and aft; others to a number of battleships attended by cruisers and destroyers; others again to a brilliantly lighted passenger train travelling in sections and seen from a distance of several miles.

Such descriptions indicate that the display was of a very unusual kind, very different from the usual quick-moving and scattered bodies. It may be of interest to reprint here in full one of the accounts. Mr. J. G. MacArthur writes:—

"There were probably thirty or thirty-two bodies, and the peculiar thing about them was their moving in fours, threes, and twos, abreast of one another, and so perfect was the lining-up you would have thought it was an aerial fleet manœuvring after rigid drilling. About half of them had passed when an unusually large one hove in sight, fully ten times as large as the others. Five or six would appear in two detachments, probably five seconds apart; then another wait of five or ten seconds, and another detachment would come into view. We could see each detachment for probably twenty or twenty-five seconds. The display lasted about three minutes. As the last detachment vanished, the booming as of thunder was heard—about five or six very pronounced reports. It sounded in the valley as if some of the balls of fire had dashed into Humber Bay. The bodies vanished in the south-east, but the booming appeared to come from the west or north-west, and the time it was heard was close to 9.12 p.m."

It is fortunate that Prof. Chant lost no time in gathering together all the available material concerning this unusual stream of meteors, and his communication is a valuable record for future reference, containing numerous charts and sketches and one coloured drawing.

THE BRUSSELS MEETING OF THE IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute was held in Brussels from September 1 to 4, after an interval of nineteen years. It will probably rank as one of the most successful of the foreign visits ever paid by the institute, and the thanks of members and their wives are due to their Belgian hosts, whose forethought had provided for every contingency, and whose charming hospitality could not have been surpassed. The chairman of the reception committee was Mons. Adolphe Greiner, the managing director of the famous Société "John Cockerill," Seraing, a works founded by an Englishman of that name in 1817, and the international character of the Iron and Steel Institute is well illustrated by the council's selection of Mons. Greiner as the president-elect. It is customary at such foreign meetings for stress to be laid on papers dealing with the particular iron and steel industries of the district, and the discussions chiefly ranged round the contributions of the Belgian members. In an interesting historical survey of the metallurgy of iron in Belgium, Baron de Laveleye shows that Liége, Charleroi, and the central district are the principal centres of production, the first-named being "the true cradle of the industry." He gave it as his opinion that at the present day the workers in the Charleroi district are inferior to none in their aptitude and endurance. At the present time Belgium retains only 20 per cent. of her iron and steel products for home consumption, and exports 80 per cent., a larger proportion than that of any other country. This being so, she is compelled to accept as an average selling price that which rules in the international export market. The cost of production has certainly been brought down to a very low figure, and the author claims that it is "only by never allowing an improvement to be made without either adopting or trying it, by relying upon the energetic and hardworking labour classes to whom free trade supplies cheaply the necessaries of life, and by constantly increasing the productive capacity of their works that the ironmasters have succeeded in maintaining the struggle on an equal footing."

It was in Belgium that the first coke ovens were constructed which were heated at the side and underneath by the gas evolved from the coal during coking, and a paper by Baron Coppée, the son of Evence Coppée, the inventor of the oven bearing this name, dealing with modern processes of coke manufacture, was therefore of unusual interest. In Belgium the beehive oven has disappeared, and 97 per cent. of the coke is made in by-product ovens. On the other hand, in England the by-product oven has made less headway, partly because the first ovens erected were by no means as perfect as they are now, and produced a coke which was undoubtedly inferior to beehive coke, and partly on account of difficulties in connection with refractory materials which resulted in defective working of the ovens. In spite of the fact that most of the English bricks resist high temperatures as well as the continental varieties, according to the author they have the disadvantage of contracting at high temperatures, thereby causing cracks and dislocations in the structure of the ovens. The result is that all the leading constructors now use Belgian or German firebricks for those parts of their ovens which are in contact with the hot gases. By means of an apparatus which was on view during the meeting the author has tested numerous varieties of firebricks from the point of view of their expansion during heating, and has found that they vary considerably in this respect. Some of them appear to undergo no expansion above 700–800° C., and above this range to remain constant. This is the best result thus far obtained. In the discussion, however, one of the speakers claimed that the life of a good English brick is from seven to eight years. The modern trend in Belgium and Germany is to produce concurrently metallurgical coke and lighting gas, and at the present day the latter country has no less than forty-five towns or communes which are wholly or partially supplied with lighting gas derived from coke ovens.

Somewhat closely connected with the foregoing was a paper by Houbaer on the utilisation of blast-furnace and coke-oven gases in metallurgy. The application of the former to the development of motive power is a problem which has been solved for some time past. It is, however, only within the last few years that the utilisation of its calorific power for heating industrial furnaces has been taken into serious consideration, and the author passes in review its employment in heating metal mixers, open-hearth furnaces, and reheating furnaces. An arrangement has been adopted at the Deutscher Kaiser Steelworks for heating the three 1200-ton metal mixers with a single burner capable of taking either blast-furnace gas, coke-oven gas, or a mixture of both with air from the Cowper stoves.

Again, at the Bethlehem steelworks coke-oven gas is being applied as the heating fuel to a battery of six 75-ton open-hearth furnaces specially built with this object, and to an existing series of thirteen 60-ton furnaces. For many years calculations have been made as to the saving in fuel and advantages in working that may be expected to accrue from an artificial enrichment with oxygen of the air blown into a blast furnace. But in spite of the claims thus put forward, blast-furnace managers have hitherto refused to make the experiment, and with some reason, for the breakdown of such a furnace would be a very expensive matter, and the tendency has been to wait for someone else to make the test. A paper by Trasenster, presented at the meeting, indicates that the step has just been taken at the Ougrée-Marihaye works in Belgium. The oxygen plant is composed of three similar liquid-air units, each yielding 200 cubic metres of oxygen per hour. No results of working are given in the paper, but during the discussion the author stated that a month's trial had been run, in which the oxygen in the blast was raised to about 23 per cent. by volume. Moreover, a small blast furnace has been built in which the working will be carried out with very high percentages of oxygen, and even with pure oxygen. There is no doubt that these tests will be watched with the deepest interest, and in particular blast-furnace managers will desire to be informed as to how the difficulties which may be expected to result from increased temperature at the tuyeres are overcome. This is the main reason why they have been so much disinclined to make the experiments with their own plants.

Mr. Talbot, the inventor of the Talbot tilting furnace, presented a paper on modern open-hearth steel furnaces, in which he discussed the reasons which have militated against their adoption on anything like an extensive scale. The two main criticisms brought against them are the initial capital outlay and the increased cost of upkeep, and these the author sought to combat and to point out some of the principal advantages which in his opinion accrued from the use of tilting furnaces as compared with those of the fixed type. With a view to settling this question in a practical fashion, one of the largest continental steel-making firms is running in the same shop furnaces of both types under exactly similar conditions of shop practice, and it was clear from the discussion that until the results of this test are known most manufacturers prefer to adhere to the fixed furnaces the particular advantages of which are well known by this time.

It is characteristic of the rapid development of electric steel processes that scarcely a meeting of the institute is held without one or more papers on this subject. The paper by Otto Frick on the electric refining of steel in an induction furnace of special type marks a distinct development in the applicability of this type of furnace the use of which has hitherto been confined to the melting of high-class steels in which no refining took place. The results are based on the data obtained in the Frick furnaces at Krupp's works in Essen, which have been in operation for the last five years. With regard to the lining, the induction furnace offers certain intrinsic difficulties owing to the ring-shaped form of the crucible. On one hand greater difficulties arise in making the lining stand high temperatures without cracking, and on the other the ring-shaped form makes it impossible to give the furnace walls sufficient slope to enable repairs to be made in the same manner as in the open-hearth furnace. The difficulties with regard to cracking are due to the fact that the outer wall is ring-shaped, and has its highest temperature on the inside, whereas the equally ring-shaped inner wall is hottest outside. The only way of overcoming these difficulties is to use a material which neither contracts nor expands appreciably at very high temperatures. The lining used is made of very pure magnesite without any binding agent, and treated in a particular way. It possesses remarkable compactness, mechanical strength, and resistance to the action of slags. But even the best linings will not stand more than a few weeks if they are not further protected against the cutting action of ordinary slags. This difficulty the author claims to have solved by adding crushed magnesite in such a way that the slag can become saturated before it is able to attack the lining, an action which is much facilitated by the inclination and rotation of the bath. In this way it has even proved possible to make the inner wall grow by adding too much magnesia, and the lining of the furnace now has a life of from two to three months, a result which represents a considerable advance on industrial practice hitherto. The foregoing account does not do more than bring out the chief points of importance discussed at the meeting. In all nineteen papers were presented, several of them of distinct scientific value and interest, but time did not permit of their discussion.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Dr. M. Bartuzzi, president of the Italian Society for the Critical History of the Medical and Natural Sciences, has been appointed to the newly established chair of medical history in the University of Siena.

Dr. Clifton F. Hodge, professor of biology at Clark University, Massachusetts, since 1902, has resigned that post, having accepted the offer of a chair in the same subject at the University of Oregon. In his new sphere Prof. Hodge will have special responsibilities in connection with a scheme of university extension lectures.

Sir Rickman J. Godlee, Bart., president of the Royal College of Surgeons, London, has accepted an invitation to confer the fellowships of the American College of Surgeons at the first Convocation of that institution, which is to be held at Chicago on November 13 next. About 1400 prominent surgeons of the United States and Canada are to be created fellows.

Dr. W. F. G. Swann has resigned his position as assistant-lecturer and demonstrator of physics at the University of Sheffield in order to take up, on October 1, the post of physicist in charge of experimental work in the new laboratory at Washington of the department of terrestrial magnetism of the Carnegie Institution of Washington.

A course of three lectures dealing with the early history of medicine has been arranged for delivery by the historical section of the Royal Society of Medicine. The first lecture will be given on October 10, by Prof. Jastrow, of the University of Pennsylvania, and will treat of Babylonian Medicine; the subsequent discourses will be delivered by Prof. Elliot Smith, F.R.S., on Egyptian medicine, and by Prof. R. Caton, on Greek medicine.

The widow of Principal Caird has bequeathed to the University of Glasgow, in memory of her late husband's long connection with the University, the sum of 4000*l.* for the founding of two scholarships, to be known as "The Principal Caird Scholarships," to be awarded annually by examination to the student in the University who is most distinguished in either classics or mental philosophy, or both. The sum of 1000*l.* is also left to the Western Infirmary, Glasgow, and 500*l.* to the professor of moral philosophy of Glasgow University for books or prizes.

We learn from *Science* that Dr. H. G. Leach, secretary of the American-Scandinavian Foundation (endowed by the late Mr. Niels Poulson with a gift of 600,000 dollars to maintain an interchange of students, teachers, and lecturers, and to promote in other ways intellectual relations between the United States and Scandinavia), has returned from an official tour in Sweden, Norway, and Denmark. Fellowships have been awarded to two representatives from each of the three countries referred to, and those selected will enter American universities in the autumn. Plans also have been discussed for an exchange of professors between the University of Copenhagen, the University of Christiania, the University of Upsala, and several American institutions.

The Northampton Polytechnic Institute, Clerkenwell, London, E.C., has now issued its "Announcements" for the session 1913–14. The educational aim of the polytechnic is to provide classes in technological and trade subjects, special attention being directed to the immediate requirements of Clerkenwell. There are day and evening courses in mechanical and electrical engineering, in technical optics, and in horology. The engineering courses include sub-sections in automobile work, aëronautics, and radio-telegraphy. In addition, there are evening courses in electrochemistry, metallurgy, and domestic economy. We notice that during the past year the equipment has been extended. Amongst the more important items may be mentioned in the mechanical engineering department a Linde refrigerating plant, available for carbonic acid or for ammonia, and an outfit for the microphotographic examination of engineering materials. In the electrical engineering department the laboratory equipment for radio-telegraphy has been increased, and additions have been made to the equipment of generators, measuring instruments, and photometers. In the metallurgical department the equipment of electric and gas furnaces and pyrometers has been augmented. A new departure is being made in the section of telegraphy and telephony in the arrangement of special classes for workmen on the maintenance and constructional staff of the Post Office, and also for boy messengers. The latter classes are intended to meet the difficulty of the blind-alley occupation into which the Post Office plunges these boys, and the experiment, which is of public interest, will be watched sympathetically.

THE prospectus of university courses in the Municipal School of Technology, Manchester, for the session 1913–14, is now available. It will be remembered that university work in Manchester was co-ordinated in 1905 by the establishment of a faculty of technology in the University of Manchester, with the principal of the Municipal School as dean of the faculty and with the heads of the mechanical and electrical engineering, of the applied chemistry, and of the architecture departments of the school as professors of the University. The University courses provided by the School of Technology lead to the degrees of bachelor and master of technical science (B.Sc.Tech. and M.Sc.Tech.). These degrees may be taken in the following divisions of technology:—Mechanical engineering, electrical engineering, sanitary engineering, applied chemistry, mining, architecture, and textile industries. In addition, the school provides courses of post-graduate and specialised study and research, in numerous branches of technical science, for a fourth year, to students who have completed the three years' course for a degree or certificate successfully, or are otherwise deemed competent to enter upon them. The School of Technology has also published departmental prospectuses of the part-time evening courses, and the apprentices' day courses to be held at the school during the coming session. The number of evening students has reached the limit of the accommodation provided by the present building, but the demand for advanced courses continues to increase, and it has been found necessary to abandon the more elementary classes, and to raise the fees in other cases. A special feature is the large proportion which the advanced work bears to the whole. This evening work in the case of a number of courses is of the same standard as that given to third year students reading for an honours degree in a British University.

BOOKS RECEIVED.

Western Australia. Astrographic Catalogue 1900·0. Perth Section, Dec. −31° to −41°. From Photographs Taken and Measured at the Perth Observatory, under the direction of W E. Cooke. Vol. ii. Pp. 100. Vol. ii. Pp. 103. (Perth, Western Australia.)

The Romance of Scientific Discovery. By C. R. Gibson. Pp. 318+plates. (London: Seeley, Service and Co., Ltd.) 5*s*.

Researches in Magneto-optics. By Prof. P. Zeeman. Pp. xv+219+viii plates. (London: Macmillan and Co., Ltd.) 6*s*. net.

Encyclopaedia of the Philosophical Sciences. Vol. i., Logic. By A. Ruge, W. Windelband, J. Royce, L. Couturat, and others. Translated by B. Ethel Meyer. Pp. x+269. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Cotton Spinning. By W. S. Taggart. Vol. i. Fourth edition. Pp. xxxvi+262. Vol. ii. Fifth edition. Pp. xiv+245. (London: Macmillan and Co., Ltd.) 4*s*. net each vol.

A First Course in Projective Geometry. By E. H. Smart. Pp. xxiii+273. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*.

The Catskill Water Supply of New York City. By L. White. Pp. xxxii+755. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 25*s*. 6*d*. net.

The Improvement of Rivers. By B. F. Thomas and D. A. Watt. Second edition, re-written and enlarged. In two parts. Part i., pp. xiv+369+plates 1–45. Part ii., pp. ix+334–749+plates 45*a*–76. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 2 vols., 31*s*. 6*d*. net.

A Treatise on Wooden Trestle Bridges and their Concrete Substitutes according to the Present Practice on American Railroads. By W. C. Foster. Fourth edition, revised and enlarged. Pp. xix+440+76 plates. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s*. net.

Weltsprache und Wissenschaft. Gedanken über die Einführung der internationalen Hilfsprache in die Wissenschaft. By Prof. L. Couturat, Prof. O. Jespersen, Prof. R. Lorenz, and others. Zweite Auflage. Pp. vi+154. (Jena: G. Fischer.) 2 marks.

Naturphilosophische Plaudereien. By H. Potonié. Pp. v+194. (Jena: G. Fischer.) 2 marks.

Egyptian Art. Studies by Sir Gaston Maspero. Translated by E. Lee. Pp. 223+plates. (London: T. Fisher Unwin.) 21*s*. net.

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2291, Vol. 92] THURSDAY, SEPTEMBER 25, 1913 [Price Sixpence.

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THURSDAY, SEPTEMBER 25, 1913.

ELECTRICAL STANDARDS.

Reports of the Committee on Electrical Standards appointed by the British Association. Pp. xxiv+783+10 plates. (Cambridge: University Press, 1913.) Price 12*s.* 6*d.* net.

THE reissue by the Cambridge University Press of the annual Reports of the Committee on Electrical Standards, with Mr. F. E. Smith as editor, has placed in our hands in a convenient form an extremely interesting chapter of the history of scientific research in this country. The committee was first appointed in 1861, as the outcome of a paper on the subject by the late Sir Charles Bright and Mr. Latimer Clark. At that time no generally recognised system of electrical units existed, and its initial object was to decide on the most convenient unit of resistance and embody it in a material standard. Its first members were Profs. W. Thomson, Williamson, Wheatstone, and Miller, Dr. Mattiessen, and Mr. Jenkin. Seven other members, including Profs. Maxwell, Stewart, and Dr. Joule, were added in 1863, and four others, including Prof. C. Foster and Mr. Hoskin, in 1867.

During the first eight years of its existence the committee displayed great activity, its first six annual reports covering 290 pages of the book, the contributions of the members named being especially prominent. As a result a unit equal to 10^9 cm. per second had been adopted, and named at first the Ohmad and subsequently the Ohm. This had been embodied in wires of several materials, and in a column of mercury of a square millimetre section and 104·85 cm. long. In its seventh report in 1870 the committee complained of the difficulty of getting its many members together, and of the remissness of its subcommittees, and suggested that the further problems of selecting units of capacity, difference of potential and current, and the construction of standards, be dealt with by new committees. Neither the old committee nor the suggested new committees were appointed, however, until 1880, when other measurements had cast doubt on the accuracy of the committee's ohm, and four of its original members, and nine others, were constituted the re-appointed committee charged with the construction of standards of resistance, capacity, and electromotive force.

For the next twenty years the activities of the committee centred round the Cavendish Laboratory at Cambridge, where under Lord Rayleigh the value of the old ohm was shown to be more than 1 per cent. too low, and under Dr. Glazebrook a systematic comparison of the various copies of the ohm was kept up for many years as a test of their relative permanency. Standard capacities were also constructed, but the middle years of this period were chiefly occupied with the Clark cell as the standard of electromotive force. The end of the period brought the question of the measurement of current by the "current balance" to the fore, and for the next decade the work of the committee was centred in the National Physical Laboratory, and fell largely on the shoulders of Mr. F. E. Smith. Under the new conditions the order of accuracy of the results obtained was rapidly increased, and at the present time measurements of electrical resistance, current, and electromotive force can be made in terms of the international units with an accuracy of about five parts in 100,000.

The work of constructing practical electrical standards for which the committee was appointed fifty years ago has therefore been achieved, and each of the twenty-two members who formed the committee last year when it dissolved, may look back with satisfaction to his share in an advance of national and international importance.

The book is well printed, the type used is larger than that of the British Association Reports, and the spacing between the lines is somewhat greater. The index covers ten pages, and much facilitates the use of the work. A list of the whole of the members of the committee, with their years of service, is given in the introduction, but the familiar headings to the reports with the names of the members, and the specification of the chairman and secretary, have been omitted, much to the present writer's regret.

C. H. L.

TRADE WASTE WATERS.

A Text-book on Trade Waste Waters: their Nature and Disposal. By Dr. H. Maclean Wilson and Dr. H. T. Calvert. Pp. xii+340. (London: C. Griffin and Co., Ltd., 1913.) Price 18*s.* net.

MANUFACTURING prosperity implies the increasing production of trade waste waters, and the increased pollution of our rivers unless the greatest care is taken to utilise or minimise such waste, or processes of purification more efficient than many of those in general use are adopted.

In north and central England the problems attendant upon the utilisation or purification of waste liquors are numerous and of special importance, but there are few districts in this country where difficulties do not occasionally arise. The authors of this work, as chief officials of the West Riding of Yorkshire Rivers Board, have had ample opportunity of gaining experience, and they have turned this to good account, having placed the results of their labours and observation at the disposal of all who are interested in the subject. The trades dealt with are so numerous and so varied in character that it has been apparently impossible to describe any process of purification of wide applicability, hence the trades are dealt with separately, and in most cases exhaustively.

The detailed illustrations of different kinds of purification plants are numerous, and greatly enhance the utility of the work. Wherever it has been found possible to utilise a waste liquor, and such cases will become more and more numerous as greater care is taken to improve the condition of our rivers, the results actually obtained are given. Upon occasions it is found that one waste liquor may be used for purifying another, in itself a process of utilisation, and upon others that by modifying a process or improving a plant the amount of waste could be markedly decreased. The authors' experience, moreover, is not limited to this country, since they have visited Germany and France to see processes actually at work, and they have availed themselves of the evidence given before Royal and other Commissions.

The book is therefore thoroughly up to date, but excellent as it is it does not solve, nor does it pretend to solve, all the difficulties with which local authorities have to deal. For example, the writer is now attempting to deal with the waste liquor from a "producer" gas plant, in which gas is made from sawdust and wood-shavings. He naturally hoped to obtain assistance by consulting this work, but the information available is too meagre. An excellent feature of the book is that it describes the origin and nature of the polluting waste liquors dealt with, and then sets out the means which have in actual practice been found most successful in dealing therewith. At the end of each section is a bibliography, which is particularly useful.

The authors are to be congratulated upon having produced a work which was urgently required, and will be as useful to the manufacturers as to sanitary authorities and their officials. It becomes increasingly obvious as our knowledge of trade processes is broadened that a great deal of the river pollution which now takes place is easily preventible, and it is to be hoped that one of the results of making this special knowledge more accessible will be to encourage both manufacturers and local authorities in their endeavours to take such steps as will tend to restore our rivers and streams to something like their pristine condition of purity.

ENGINEERING MANUALS AND TEXT-BOOKS.

(1) *A Course of Elementary Workshop Drawing.* By H. A. Darling. Pp. 172. (London: Blackie and Son, Ltd., 1913.) Price 1*s.* 6*d.*

(2) *A Text-book on Field Fortification.* By Colonel G. J. Fiebeger. Third edition. Pp. ix+155+xxvii plates. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 8*s.* 6*d.* net.

(3) *Machine Construction and Drawing.* By A. E. Ingham. Pp. xii+143. (London: George Routledge and Sons, Ltd., 1913.) Price 1*s.* 6*d.* net.

(4) *Earthwork Haul and Overhaul, including Economic Distribution.* By Prof. J. C. L. Fish. Pp. xiv+165. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 6*s.* 6*d.* net.

(5) *Continuous Beams in Reinforced Concrete.* By Burnard Geen. Pp. iv+210. (London: Chapman and Hall, Ltd., 1913.) Price 9*s.* net.

(1) THIS work on elementary drawing is well arranged and concisely written. It takes the student up to (but not including) intersection of solids, and leaves him there with a crop of good ideas regarding the use of familiar drawing instruments, and the elements of orthographic projection and isometric drawing. The catechisms in the form of elementary exercises throughout the book are a useful addition. Works on this subject are seldom charged with a sufficient supply of such examples. The chapter on "full-size drawing" is a commendable innovation, for much work is laid out on a floor full size in a workshop, and a knowledge of how to lay out designs in this manner forms a part of the work in a structural iron works or boiler shop, while for a moulding loft it is especially necessary. It would have been preferable if more space had been devoted to orthographic projection, and less to isometric projection. Moreover, the student finds it easier to proceed to the latter from the former, and too much time cannot be spent in assisting the learner to think in three dimensions. This little book should commend itself to teachers in elementary mechanical drawing.

(2) This edition is entirely re-written to bring it up to date, the more necessary as the science of field fortification expands with the experience derived from modern wars. The precision and penetrating power of the firearm to-day have raised the duty of the sapper to an importance now fully recognised, and instruction in the rapid construction of shelters for an army is one of the principal features of military science and engineering. The

author, who is professor of civil and military engineering at the Westpoint Military Academy, draws extensively upon the experience gained in recent wars, as far back as the American Civil War, and up to the Russo-Japanese war. In this period much has taken place to modify field works and entrenchments, and the art of concealment due to the use of smokeless powder becomes one of the characteristic features of military field work. It would be impossible to follow the author through the various types of entrenchments, breastworks, embankments, stockades, palisades, revetments, blockhouses, and buildings, that he describes and illustrates. It is all clearly set forth in short, if somewhat disjointed, sentences. The chapters on passage of rivers and military demolitions contain little that is new, but there is quite enough new material in the book without expecting something fresh on every page. The work should prove to be valuable to the student of military science.

(3) In the preface the author states his intention of providing a course of training in machine construction and drawing, not only to conform to the requirements of actual workshop practice, but to provide approximately a year's work in the evening technical school. This he has done by rendering numerous examples of parts of machines, reserving for each general type a separate chapter, the first four chapters being devoted to such elementary matters as nuts, bolts, screws, and riveted joints. The student is supposed to have a fair acquaintance with mechanical drawing before entering on the subjects in this book. The machine details and examples are of the usual pattern.

(4) Perhaps a more descriptive title for this book would be one which conveyed the impression of economical operations in excavations and fillings for railways, for such is the matter of which it treats. The term "overhaul" is employed to describe a distance of hauling excavated materials in excess of a specified distance on the basis of which the contract is let. Overhaul is the product of the number of cubic yards hauled by the average overhaul distance. The unit of haul used throughout the work is the station-yard, the station being a distance of 100 ft., and the volume the cubic yard. By taking cross-sections of cuts and fills mass curves are drawn, due allowance being made for the "swell ratio," or the increase in bulk resulting from moving the material from its initial position to a fill. The engineer and contractor would derive much condensed information from the examples that are worked out, showing for different cross-sections the most economical way of handling the material. Such problems are, however, capable of indefinite variations, but the author has covered the ground by illustrative types which point the way to solutions in special cases.

(5) In the form of diagrams information is set forth for the rapid calculation of the maximum possible bending moments, vertical and horizontal shearing forces, and stirrups or binding for any number of equal continuous spans with any possible arrangement of loading of complete spans for all types of loading generally met with in practice. The work contains sixty-nine diagrams besides tables, and the bending moments and shear for continuous girders up to five spans are shown. It would have added considerably to the value of the work if scales had been put to all the diagrams; as it is, some of them are bare, without any scales or reference marks. They are very instructive as showing the variation of bending moment and shear in continuous beams, and are capable of wide application.

DIET AND HEALTH.

(1) *Health Through Diet: A Practical Guide to the Uric-Acid-Free Diet.* By Kenneth G. Haig. With the Advice and Assistance of Dr. Alexander Haig. Pp. x+227. (London: Methuen and Co., Ltd., n.d.) Price 3*s*. 6*d*. net.

(2) *The Elements of Heating and Ventilation.* A Text-book for Students, Engineers, and Architects. By Prof. A. M. Greene, jun. Pp. vi+324. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 10*s*. 6*d*. net.

(3) *Chloride of Lime in Sanitation.* By A. H. Hooker. Pp. v+231. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.)

(1) THIS little volume is most practical in its treatment of problems of diet. The author approaches the subject with such whole-hearted enthusiasm that he equals, if not excels, that of his father, whose work he continues and extends. The rules emphasised as to selection of food are to secure ample proteid, and a preferential position for this in making up a dietary, so that digestion shall not be previously weakened by any less valuable constituent.

Four classes of food are given, the above coming first, then the cereals, then a mixed group of fruits and vegetables with the vegetable and animal fats. Lastly foods containing no nourishment (proteid)—tapioca, arrowroot, and commercial cornflour. Two meals a day are recommended, the optima being 11.30 a.m. and 7.30 p.m., though the author admits practical difficulty in the former.

An interesting claim made is that the use of hard water causes visceral retention of uric acid. The rheumatism of peasants using but little meat in certain districts of Ireland, Wales, and Scotland he attributes to the abuse of tea, and in a lesser degree to exposure to cold. In referring to the "frugivorous teeth" of man it is suggested that the proneness to decay may be in the nature of a penalty for attempting to use these as "carnivorous" organs. No mention is made here of the dentists' opinion that the essentially decay-producing foods are those "claggy" with local acid fermentation to follow, *e.g.* the bun and glass of milk at night.

(2) This work will appeal especially to the engineer, as the author has endeavoured throughout to give the data and laws required in designing to any specification. Following American practice, very low outer temperatures are reckoned with, such as 0° F. as lasting some days.

The temperatures set forth as optima for various kinds of room are higher than those in use in this country. Thus a hospital ward is taken at 72° F., and rooms, offices, and laboratories at 70° F. Chimneys—other than furnace-flues—appear to be unknown, implicit reliance being placed on a combination of air warming with induction or exhaustion methods.

The section dealing with the flow of air in ducts is well considered, and the anemometer is recommended for velocities not exceeding 1500 ft. per minute. After reviewing the Pitot, Venturi, and orifice devices the author mentions a novel and ingenious method depending on the increased temperature found after using a known amount of electrical energy, and so from this arriving at the mass of the air so warmed.

The criterion adopted for purity of the air is the old chemical standard of carbonic acid, where, taking 4 per 10,000 as low, 11 as causing oppression, 7 is taken for those ill, and 15 permissible in a group of healthy persons. An estimation apparatus in portable form, adapted for accurate work with small amounts of air, is illustrated and described, and appears likely to give good results as the pressure correction is simple and delicate.

Humidity has to be considered where air is artificially warmed, and various forms of apparatus are shown, though the hot-air system outlined at the commencement appears to have none. Prof. Greene points out the objectionable features of both extremes, but does not realise how, to English ways of thinking, the dryness is usually overdone. He points out a weak point in Mason's hygrometer, namely, its inaccuracy in still air, but the sling instrument shown does not impress one as practicable for average observers.

The discussion of the wet-bulb temperature and its cause for exceeding the dew-point is lucid and interesting. Carrier's work showing the mode of warming the wet bulb by heat rendered sensible is quoted briefly. After alluding to the disturbance of the mucous membranes by exposure to air itself too dry, no reference is made to the well-known feelings of malaise and depression brought about by life in a system of manipulated air monotonous in character. No matter what may be the carbonic-acid content, the normal cutaneous stimulus is lost.

(3) The author of this monograph is the technical director of a large American electrochemical company. The work falls into two portions: (1) The text—in which is a general description of the substance and its mode of action. This is continued by accounts of six main applications to public health work, thus: Water purification, sewage disinfection, street flushing, medical and surgical uses, agricultural, house-fly campaign (68 pp.). (2) A series of summarised references and reports dealing very fully with American practice, but which also includes many quotations from English publications (154 pp.).

The mode of its action being essentially that of oxidation is well stated, and the confusion with chlorine preparations pointed out.

The relative unsuitability of copper sulphate additions to polluted water destined for animal consumption is well brought out in the account of the Chicago stockyard and the sewage-contaminated waters of Babbly Creek. The animals were found to thrive less than when allowed to drink city water. The change was made to hypochlorite treatment, with the result that a purer water organically was obtained than from the city mains by some thirty-seven times less *B. coli* frequency.

Limits to the powers of hypochlorite are given on pp. 22 and 23. But though small in quantity, it should be clearly shown that some increase in hardness is inevitable in the water treated by it.

The volume concludes with an admirable index arranged separately under subjects and names.

OUR BOOKSHELF.

The Under Dog: a Series of Papers by Various Authors on the Wrongs Suffered by Animals at the Hand of Man. Edited by S. Trist. Pp. xv + 203 + v. (London: *Animals' Guardian* Office, 1913.) Cloth, 3*s*. 6*d*.; paper, 1*s*.

APART from the main title, which is much more suitable for a novel, and utterly fails to convey the faintest inkling as to the nature of its subject, the editor and authors of this volume are to be congratulated on the fair and temperate manner in which they have brought their case before the court of public opinion. Pain and suffering are unfortunately inseparable from the lot of many kinds of domesticated animals, as well as of those wild species which are hunted for sport or for their spoils; but it is the bounden and paramount duty of all civilised nations to see that these are reduced to the smallest possible minimum. Those who read this book—and it is, for the most part, at any rate, very painful reading—will, however, be convinced that even in our own country matters too often are by no means as they should be in this respect. In fact the authors have, unhappily, in many instances, a very strong, and in almost every instance a very sad, case; and it is sincerely to be hoped that their book may be the means of bringing to pass a better state of affairs in regard to our treatment of the lower animals in such cases as amendment and amelioration are most urgent and at the same time practicable. Apart from the ruthless slaughter of birds for their plumage—accompanied too frequently by the lingering starvation of their helpless young—one of the worst and most pitiable cases in the whole sad story is the treatment meted out to worn-out horses; and it must indeed be a hardened heart which is not rent by the illustrations depicting these wretched animals on their last journeys. Fortunately, several European Governments are already awake to the need of stringent measures to remedy this crying evil, and we trust the present volume may give a further stimulus to their efforts. R. L.

Les Moteurs Thermiques dans leurs Rapports avec la Thermodynamique. Moteurs à explosion et à Combustion. Machines Alternatives à Vapeur. Turbines à Vapeur. By F. Moritz. Pp. vi+297. (Paris: Gauthier-Villars, 1913.) Price 13 francs.

In writing this book on heat engines the author has divided very unequally the space given to engines operating with external combustion and those in which combustion takes place inside the cylinder. By far the larger part is given up to the steam engine, and particularly the steam turbine. As is usual in French books, mathematical analysis is the natural line of approach to any difficult problem, however obscure the relationship of theory and practice. The book is divided into six chapters, of which the first two relate to the laws of thermodynamics—and a very careful and complete statement of them is given—to gaseous cycles and to a concise explanation of what is meant by entropy.

The twenty-five pages of chapter iii. are made to suffice for the application of preceding theory to the gas engine, and as a natural consequence of such compression the conclusions reached are incomplete. The gaseous mixture used in the gas engine is throughout assumed to have a specific heat quite independent of all temperature changes—an assumption which naturally removes almost all practical value from any conclusions which may be arrived at on theoretical grounds. The chapter concludes with the following quaint suggestion:—"On peut en tirer des conclusions practiques intéressantes, par example, sur l'influence de la circulation d'eau autour des cylindres. Nous laissons au lecteur le soin de faire cette comparison pour tous les cas qui peuvent se présenter à lui."

Chapters iv., v., and vi. (some two hundred pages) are given up to piston steam engines and steam turbines. The author shows much skill in his analysis of the theory of jets and of turbine flow; he treats very fully also of turbine leakage, and uses freely the entropy diagram to illustrate his meaning. Students of the steam turbine will find M. Moritz' book both interesting and stimulating.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

The Spectra of Helium and Hydrogen.

With regard to Mr. Evans's communication to Nature, September 4, p. 5, I should like to remark that while I have for some time recognised that the experimental evidence, on the whole, seems to be in favour of helium as the origin of the new lines 4686, &c., it should not be too hastily concluded that they are not due to hydrogen. Mr. Evans appears to have succeeded in eliminating the ordinary spectroscopic indications of hydrogen from his helium tubes, but is it not possible that, under the special conditions of the strongly disruptive discharge, with helium also present, residual hydrogen may be represented only by the new lines? This would not be the only known case in which the presence of helium aids the development of the spectrum of another gas with which it is mixed. I have observed this effect in the case of the series of bands of carbonic oxide which are characteristic of the tails of comets; these bands are of very feeble intensity at the low pressures necessary for their approximate isolation in the spectrum of the pure gas, but I have seen them greatly intensified when carbonic oxide was present as an impurity in helium. Also, the Ritz series of infra-red hydrogen lines was found by Paschen to be brighter in a mixture of hydrogen and helium than in hydrogen alone. Apart from this, I find it difficult to believe that the close agreement of one set of lines with the principal series calculated for hydrogen by Rydberg is merely accidental.

Dr. Bohr's theory (*Phil. Mag.*, July, 1913) does not at present seem to me to give much evidence for helium, in preference to hydrogen, as the origin of the lines in question. The formula derived from the theory gives no better agreement with the observations than that of Rydberg, so far as the two are comparable, and apparently requires that the seven observed lines, beginning with 4686, should be capable of arrangement in a single series. I think, however, that the lines cannot be so united within the limits of error of observation, though very nearly so, and I believe that my separation into two series converging to the same limit is correct. The necessity for two series is rather more clearly indicated in the case of the analogous series of magnesium spark lines which I have lately described (Proc. Roy. Soc., vol. lxxxix., p. 133). Moreover, the merging of two such series into one formula is open to the objection that it involves multiplication by 4 of the series constant, which would otherwise be universal. It may be possible, however, to test this point by observations of the Zeeman effects on the lines, and I shall make this experiment at the first opportunity.

I may add that experiments made by Prof. Strutt and myself are in harmony with those of Mr. Evans in showing that the lines under consideration do not occur in mixtures of hydrogen with neon or argon.

A. Fowler.

Imperial College of Science and Technology, South Kensington, September 13.

The Elephant Trench at Dewlish Was it Dug?

The Rev. Osmond Fisher makes the interesting suggestion that the curious trough at Dewlish, in which numerous remains of *Elephas meridionalis* were found, was an artificial trench, dug as a sort of pitfall to intercept and disable wild animals driven across it. Perhaps, as having seen the excavations made by Mr. Mansel-Pleydell, I may say a word on this point.

Open trenches in the soft chalk are unknown elsewhere, though they are common enough in the hard mountain limestone. I therefore examined this trench most carefully, in order to find out how it had originated, and whether man had had anything to do with it. I am still much puzzled as to its exact mode of excavation; but certain peculiarities convinced me that it was due to natural agencies, and that it was probably cut by the swirl of the fine dust-like quartz-sand which, mixed with polished flints, now fills its lower part. I could find no implements, and could nowhere see traces of pick marks. The sides of the trench, where not damaged by the workmen who had just cleared it, were curiously smooth; but the flint-nodules projected into the cavity from either side, as though the softer chalk had been scoured away. The abrupt rounded end of the trench was most peculiar, and as I cleaned this out myself, dusting away the sand from the smoothed face of the chalk, I am sure that there were here neither tool-marks nor rubbings such as might be made by a man working in the trench, or by wild beasts. In short, the smooth, rounded contours suggested the eddying of wind, and the absence of any crack or joint showed that here at any rate the rounding was not likely to be due to percolating water.

Beneath the elephant bones, which occurred in a layer a few feet down, the infilling of the trench seems to be a fine dust-like, unfossiliferous sand, which was not bottomed, as Mr. Mansel-Pleydell's excavations were made primarily to obtain elephant remains, and these were in such a soft condition as to make removal almost impossible. If this sand-filled fissure is found to continue downward, but is too narrow for a man to work in, it will show that the trench is not artificial. I could only just squeeze past in one or two places; but the upper part of the trench was passable; I think, however, that it tended to narrow downward, but at the time of my visit the bones had not been removed, and I could not excavate below them.

Perhaps someone acquainted with plateaus of soft limestone under desert conditions can say whether there is any tendency for the wind to cut trenches with rounded blind ends, such as the Dewlish trench has. In this connection, it is worth noting that our newer Pliocene land-faunas show distinct indications of drier and more sunny conditions than we have at present. A gazelle, an antelope, and several land and fresh-water mollusca point in that direction. Under dry conditions, and before the loose flints were swept away during the glacial period, our chalk-downs would probably be stony deserts, quite unlike the green hills we now see.

Clement Reid.

Milford-on-Sea.

Red-water Phenomenon due to Euglena.

The red-water phenomenon due to a Euglena described by Prof. Dendy in Nature of August 7 has been observed by me in Pretoria. In this case, however, the Euglena swims freely about in the water, and also forms a red gelatinous scum on the surface of the damp mud on the side of the pond. In swimming they seldom show euglenoid movement. A flagellum longer than the body can be easily seen under the microscope at the anterior end of the body, but it always trails along the body with lashing movements. If they become stranded on the mud at the edge of the pond, they soon become spherical and encysted in a mucilaginous covering much wider than the body and showing a layered formation. I have not observed any bubbles of gas given off, although I have kept large quantities of them under observation for long periods. They appear to prefer the encysted form, as they always swim to the edge of the vessel towards the light and form a deep red line along the edge, which gradually becomes dry. If more water is added and the vessel turned round, they will leave their cysts and again swim towards the light side. They are of a fairly large size, and have a cylindrical body tapering to a sharp point at the posterior end, where the last portion is free from pigment Chlorophyll is present, and is easily seen amongst the red in those that have just come out of the encysted stage, but later on it entirely disappears.

Horace A. Wager.

Transvaal University College, Pretoria. August 30.

Distance of the Visible Horizon.

Mr. W. Moss's account in Nature for August 7, p. 583, as to how to get the area of a sphere theoretically visible at any altitude is interesting; but can he, or any of your readers, say what the formula is for obtaining the distance actually visible with an average amount of refraction? So far as I can discover, all ordinary books of tables ignore this, although such a table would be very useful.

A table is given in Chamber's Mathematical Tables, p. 436, for the distance of the visible horizon, but the explanation, p. xl., states that this is theoretical, and that a correction for refraction should be made, although nowhere is any table or formula given for such correction.

T. W. Backhouse.

West Hendon House, Sunderland September 6, 1913.

Atmospheric refraction is such a varying quantity that no rule respecting it can be laid down applicable in all circumstances; as in cases of mirage, for instance, where vessels below the horizon are seen standing above it, and turned upside down. The refraction of the sea horizon is the great difficulty in obtaining correctly the position of vessels at sea. This can be eliminated in most cases by taking observations of the heavenly bodies to opposite sides of the horizon; for latitude in a north as well as in a south direction; for longitude in an east as well as in a west direction. When only one heavenly object is available this is not always practicable, but it can be done when the altitude is 60° or upwards.

In the appendix to Captain Parry's "Arctic Voyage, 1821–3," p. 187, some observations of the sea horizon by Mr. Fisher are given. He found a variation of 18° in the Arctic region, the ice horizon being elevated in summer and depressed in winter. The variation of the place of the apparent horizon, as a question of unequal temperature, was discussed generally by M. Biot in 1809. But no detailed observations on the subject have, so far as I am aware, been yet made.

The correction for refraction in obtaining the heights of mountains by angles of depression to the waterline of points or lighthouses, or by angles of elevation from points the height of which has been ascertained, is taken empirically, in nautical surveying, as $\frac{1}{12}$th the distance of the object observed. The results thus obtained are fairly accurate. For instance, when surveying the Gulf of Suez in 1871, the observations from the summit of Jebel Hooswah gave the results shown in the accompanying table.

T. H. Tizard.

Place of observation	Object observed	Angle of elevation	Angle of depression	Refraction + or − $\frac{1}{12}$ dist.	Corrected angle	Dist.	Diff. of level	Height of Object observed	Height of Theod.	Dip.	Corrected height Place of observer	Corrected height Object observed
Summit of Jebel Hooswah	Water line of Tur point...	—	1° 27′ 30″	+1′ 21″	1° 28′ 51″	16′·38	2573	0	5 ft.	237	2331	0
	,, at Tur	—	1 20 0	+1 31	1 21 31	18·24	2633	0	,,	292	2336	0
	,, Marabut point	—	3 57 0	+0 27	3 57 27	5·48	2303	0	,,	26	2272	0
	,, point this side of Marabut	—	4 1 0	+0 26	4 1 26	5·35	228-	0	,,	24	2258	0
	Water line to the right ...	—	4 49 0	+0 23	4 49 23	4·60	2358	0	,,	19	2334	0
	,, of station point	—	16 12 0	+0 6	16 12 6	1·30	2295	0	,,	1	2289	0
	,, of another point with station ...	—	11 18 0	+0 9	11 18 9	1·85	2246	0	,,	3	2238	0
	Water line of another point	—	8 54 40	+0 12	8 54 52	2·40	2257	0	,,	5	2277	0
	,, by Asses ears..	—	6 14 0	+0 17	6 14 17	3·48	2311	0	,,	11	2295	0

Mean height 2292 ft. Max. height observations 2336. Minimum 2238. Range 98 ft.

For greater distances and heights the angles from and to Jebel Serbal may be given as follows:—

Place of observation	Object observed	Angle of elevation	Angle of depression	Refraction + or − $\frac{1}{12}$ dist.	Corrected angle	Dist.	Diff. of level	Height of Object observed	Height of Theod.	Dip.	Corrected height Place of observer	Corrected height Object observed
Summit of Jebel Serbal	Water line of Gharib lighthouse	—	2 6 0	+2 47	2 8 47	33·48	7623	0	,,	989	6629	0
	Water line of Zaffarana lighthouse	—	1 28 0	+4 53	1 32 53	58·55	9613	0	,,	3025	6583	0
	Point to south-east of Zaffarana lighthouse ..	—	2 25 0	+2 24	2 27 24	28·9	7533	0	,,	737	6791	0
	Abu Zenina point	—	1 58 0	+3 07	2 1 7	37·33	7994	0	,,	1230	6758	0
	Water line Tur Spit ...	—	2 42 0	+2 4	2 44 4	24·90	7225	0	,,	551	6699	0
	Summit of Jebel Hooswah	—	2 30 0	+1 29	2 31 29	17·92	4801	2292	,,	285	6803	2292

Mean height 6706 ft. Max. 6803. Min. 6583. Extreme range 220 ft.

The Undagraph.

Last week the Dominion Astronomical Observatory installed at Chebucto, near Halifax, Nova Scotia, a wave-counter, which I have called an "undagraph." The site, a granite cliff 110 ft. high, on which is a lighthouse, faces the broad waters of the Atlantic. The coast hereabouts is bold and rocky.

Modern seismographs record tremors of the earth—microseisms—not attributable to earthquakes, and investigators have traced them to the action of the sea during storms. These microseisms manifest themselves particularly markedly in Ottawa and in Europe from autumn to spring, *i.e.* during the winter or stormy season. Their period ranges, say, from four to seven seconds, and the greater the storm or steeper the gradient of the "low" on the water along the coast, the greater is the amplitude of the microseisms.

In order to correlate the period of the waves of the ocean which pound upon the coast with the period of the microsiesms, the above instrument has been installed. It may be mentioned that a trial instrument was made for the International Seismological Association by the Cambridge Instrument Company, and installed on the pier at Newcastle-on-Tyne. It did its work, but the position is not suitable for the purposes of correlation. The west coast of Ireland or of Norway would have been better. However, practical difficulties stood in the way for utilising either for the trial instrument. The present instrument, made by the same company, has been improved on the former, but has as yet no contrivance for registering the height or magnitude of the waves, which is so very desirable.

The principle of the instrument is very simple. It is based on Boyle's law, PV = constant. An iron pipe—in our case 625 ft. long—is led from the instrument, the diaphragm part, to and into the ocean to a depth beneath the trough of the assumed highest waves at low tide, say 15 ft. The sea-end of the pipe is open. The wave passing over it causes the water to rise in the pipe and compress the air beyond, whereby the leather diaphragm is raised, and electric contact is made. By means of the armature of an electromagnet a toothed wheel is pushed forward, one tooth for every wave, and with one revolution, or 120 waves, the recording pen returns to its zero. The record presents a series of finely serrated oblique lines, each representing 120 waves. Clockwork with pen traces at the edge of the paper a time scale, making a break every hour, the linear measure of which is 6 cm. A fresh roll of paper is put on once a week. A small leak is provided in the diaphragm chamber, to cut out the effect of the slowly rising and ebbing tide, which, however, does not affect the rapid action by the waves.

The sea-end of the pipe gives the most anxiety, as it has to resist the immense force of the waves during storms. The greater part of the 625 ft. is of half-inch galvanised iron pipe, while the ocean end, about 100 ft., is of four-inch pipe, with reducing pipes between the preceding two. The bedding of the submerged part will be in about four tons of concrete with iron girders surrounding the pipe. The whole subject is so new that we have to feel our way in this investigation. Here in Ottawa, three hundred miles from the nearest sea-coast, we have in a general way correlated microseisms recorded by the seismograph with the storms along the Atlantic coast from Cape Hatteras to St. John's, Newfoundland, a distance of 1500 miles, so that for an exhaustive study there should be quite a number of undagraphs installed. However, a beginning has been made at Chebucto, distant in an air-line about 620 miles from Ottawa, and the results will be published as soon as available.

OTTO KLOTZ.

Dominion Astronomical Observatory,
Ottawa, September 5.

Geographical Distribution of Phreatoicus.

THE occurrence of the isopod Phreatoicus in a fresh-water stream near Cape Town, in South Africa, as recorded in your issue of June 12 by Mr. Keppel H. Barnard, is of very considerable interest from the point of view of the geographical distribution of the group. Since I described the first species of the genus in 1884 our knowledge of this group has grown very rapidly, and there are now known three species of Phreatoicus in New Zealand, two subterranean and one from surface waters, and several species grouped under allied genera from Australia and Tasmania. The genus is shown both by its generalised character and by its distribution to be an ancient one. I have long considered that it is probably a fresh-water form that has developed in subantarctic lands, and its discovery in South Africa seems to confirm this. In New Zealand it appears to be confined to the more southerly portion, but it was not found in the subantarctic islands to the south of New Zealand when these were visited in 1907. It should, however, be looked for in other subantarctic islands, particularly St. Paul and Amsterdam Islands in the Indian Ocean, and the Falkland Islands and adjoining parts of South America.

CHAS. CHILTON.

Biological Laboratory, Canterbury College, N.Z.,
August 7.

The Characters of Hybrid Larvæ obtained by Crossing Different Species of the Genus Echinus.

I HAVE carried out this summer hybridisation experiments on certain species of echinoids, and, in view of the interesting condition in which this inquiry was left last year by other workers, I venture to think that my results may be worth recording.

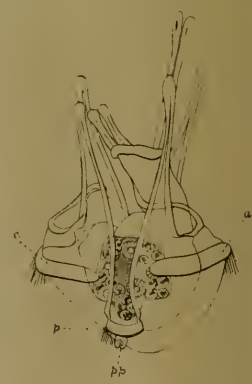
In 1911, Shearer, De Morgan, and Fuchs, as the result of three seasons' crossing experiments at Plymouth, stated (Journal M.B.A., ix., 2) that the hybrids between *Echinus miliaris*, on the one hand, and *E. esculentus* or *E. acutus*, on the other, showed, in respect of certain larval characters, a purely maternal inheritance. In 1912 the same workers, in a letter to NATURE, and later in *The Quarterly Journal of Microscopical Science*, published the result of their latest experiments, which was, briefly, that when *E. miliaris* was mother the inheritance was *paternal*. They found one culture which was exceptional. Debaisieux, working at the same time, and independently, first in London upon Plymouth material, and afterwards at Millport, obtained substantially identical results. These results he expressed in terms of dominant and recessive characters in the larvæ.

This disparity between the results of 1912 and those of former years raised a number of interesting questions, and made urgent a repetition of the experiments —a work that at the suggestion of Prof. E. W. MacBride (whose encouragement and advice I gratefully acknowledge) I undertook to perform.

The species used by me were those mentioned above, and the symbols, **M** and **m**, **E** and **e**, **A** and **a**, may be used to represent the ♀ and ♂ gametes respectively of each of them, the zygotes being then written **Mm**, **me**, **Em**, **Ee**, &c. The larval characters, the inheritance of which was studied, were the green pigment masses of **Mm** plutei, on one hand, and, on the other, the posterior pair of ciliated epaulettes and the posterior pedicellaria of **Ee** and **Aa** plutei. Debaisieux found the first of these "recessive," the other two "dominant."

In London I succeeded in raising cultures of **Mm**, **Em**, and **Am** plutei only, the reciprocal crosses failing for want of ripe males. Plymouth sea-urchins were used, and sea-water from Lowestoft. The hybrids, without exception, showed maternal characters. But in these crosses the dominant characters of Debaisieux were also maternal characters. I accordingly made further experiments at the Millport Marine Biological Station during July and August, using *E. miliaris* and *E. esculentus* only for my crosses.

After many failures, four healthy cultures of the **Me** cross were reared, one culture to a stage at which the anterior epaulettes were formed, the other three to the stage of metamorphosis. In the first culture green pigment was absent from all the larvæ examined; in the other three cultures all the individuals (132) had posterior epaulettes, eighty-one had the posterior pedicellaria, none had green pigment.



The reciprocal cross agreed in its characters with the one made in London.

There was a very notable difficulty in making the **Me** cross —a difficulty which would seem to be intrinsic, and unconnected with any defect in the egg, because it has occurred again and again in experiments in which the **Mm** and **Ee** controls have both yielded good cultures of plutei. The *E. miliaris* used as parents were small, and the ovaries contained a large proportion of unripe eggs; but a majority of the apparently ripe eggs developed, when fertilised with sperm of their own species, while only a small proportion developed when *E. esculentus* sperm was used.

The mortality in the **Me** cultures finally examined was unusually low after the blastula stage, and could be assessed with considerable accuracy on account of the small number of individuals in a culture. Differential mortality would seem then to be improbable as accounting for the final character of a culture.

The sketch shows a hybrid pluteus (**Em**) as seen from the left side: *a*, anterior epaulettes; *p* posterior epaulette; *pp*, posterior pedicellaria.

H. G. NEWTH.

Zoological Department, Imperial College of
Science and Technology.

THE "GESELLSCHAFT URANIA" OF BERLIN.

An illustrated article on the "Gesellschaft Urania" of Berlin, by Dr. P. Schwahn, appeared in the June issue of *Himmel und Erde*.

On April 29 the society celebrated its twenty-fifth anniversary, when a distinguished audience gathered in the large theatre of the Urania building in the Tauben-strasse. Among those present were representatives from the various state departments of Germany and from the municipality of Berlin; members of the professorial staff of the University and the Charlottenburg Technical Institute; representatives of the various learned societies of Germany and many members of the leading technical and manufacturing firms of Germany. During the course of the evening a congratulatory telegram was read from the Kaiser. The proceedings were opened by Prof. Foerster, who gave a brief historical survey of the origin and work of the society during the last twenty-five years, and a lecture was delivered by Prof. Donath, the director of the physics department of the institution, in the course of which some of the most recent results and applications which have arisen from the classical discoveries of Hertz and of Röntgen were demonstrated.


The "Urania" Observatory, in the Ausstellungs Park.

The society was formed in 1888, at a time when the applications of electrical science were beginning to excite the interest of the general public. Its object was the foundation of an educational institution which should foster and stimulate the interest of the people in scientific knowledge and acquaint them with the more important advances and applications of science. Among the originators of the scheme were Werner von Siemens and Prof. Wilhelm Foerster, the director of the Royal Observatory of Berlin. The Minister of Education expressed his sympathy with the scheme and through his kindly interest a suitable building site was obtained in the Ausstellungs Park, near the Lehrte Bahnhof. By the aid of public subscriptions the building "Urania" was erected and equipped. The building contained a lecture theatre, galleries for the exhibition of scientific apparatus, and an astronomical platform.

The first director of the institution was Dr. Wilhelm Meyer, and the popular lectures on astronomical and geological subjects which he organised proved a great source of attraction. Urania became a popular scientific theatre and was visited by the residents of Berlin with as much eagerness as the opera house or the theatre. The institution, however, did not limit its activities to the provision of popular lectures; systematic evening courses in physics, electrotechnics, chemistry, biology, and astronomy were arranged, and from time to time eminent men of science both of Germany and other countries were invited to lecture on special subjects.

The need of more extended premises was soon felt, and as the Ausstellungs Park was somewhat difficult of access, it was thought desirable to obtain a site in the centre of the town. Consequently, in 1896, the operations of the society were transferred to a much larger edifice in the Tauben-strasse and designated "Urania." The old building in the Ausstellungs Park, now known as the "Urania Sternwarte," passed into the hands of the Government, and with the removal of the Royal Observatory from the Encke Platz in Berlin to Neubabelsberg is now being utilised with its equipment as an astronomical institute in connection with the Berlin University. Lectures on astronomy are still given at the Observatory by the society during the winter months, but only a portion of the building is open on special days in the week to visitors. The large refracting telescope, which has a focal length of five metres and an aperture of 314 millimetres, and other smaller telescopes and instruments may still be inspected by the public, and on the appearance of comets and occurrence of eclipses the Observatory is visited by large numbers of the general public.

The "Urania" building, Tauben-strasse, Berlin.

The new institute in the Tauben-strasse, which is under the direction of Dr. Schwahn and Franz Goerke, contains a large lecture theatre with seating accommodation for 700 people and a smaller lecture room to hold 200. It is also provided with library and reading-room, workshop and preparation rooms. The scientific exhibits are placed in six galleries, two being allotted to physics, two to natural science, one to chemical technology, and one to machinery. The apparatus exhibited in the physics section has been arranged to illustrate an ordinary college course in experimental physics. It is possible for the visitor to perform for himself many of the experiments he would see demonstrated in a lecture or carry out in a laboratory. Thus, he may verify the ordinary laws of optics, measure a resistance with a metre bridge, excite the kathode rays and deflect them with a magnet, and so on. This idea was due to Prof. Goldstein, who had the arrangement of the physics apparatus in the smaller building in the Ausstellungs-Park. A similar plan, wherever possible, has been followed in the other departments, and no doubt has proved extremely beneficial to many earnest students who prosecute their studies in their spare time or lack the opportunity of a college training.

During the last sixteen years the average annual number of visitors to Urania has been 200,000, and the society has arranged on an average 700 lectures yearly. Urania has welcomed the members of the various scientific congresses which have held their conferences in Berlin during the past few years, and the institution numbers among its visitors many of the world's leading men of science. From many of these the society has received gifts of various objects of scientific interest.

The popular scientific lectures have been given in many of the larger German towns, and in 1903 the society was invited by the Russian Government to conduct a series in St. Petersburg. Urania took part in the organisation of the German educational section at the Brussels Exhibition of 1909, and was granted a premier award by the Commissioners of the exhibition. With the advent of the kinematograph the popularity of the institution is still further ensured, and at the present time great interest is being displayed in the exhibitions in the domain of hygiene and the laws of health. Urania is undoubtedly fulfilling the wishes of its founders and has become an established factor in the educational life of Germany.

Magnetism and electricity gallery of the Urania Society, Berlin.

THE FAUNA OF THE SANDWICH ISLANDS.[1]

IN 1890 a Joint Committee of the Royal Society and of the British Association was formed "to report on the present state of our knowledge of the Sandwich Islands," and it at once entered into relationship with the Trustees of the Bernice P. Bishop Museum at Honolulu. It wisely decided to restrict its investigations to the land fauna, and it recently issued the last part of its "Fauna Hawaiiensis." Its chairmen have been Sir W. H. Flower, Prof. Alfred Newton, and Dr. F. D. Godman, while Dr. D. Sharp and Prof. S. J. Hickson have respectively been secretary and treasurer during the twenty-three years of its existence. A number of the greatest authorities collaborate in the production of the "Fauna," which throughout has the high standard usually associated with the name of Dr. Sharp. Dr. R. C. L. Perkins was the collector and naturalist, and in both lines he is pre-eminent.

Hawaiia has about the area of Yorkshire, and consists of eight main islands, of which the fauna of six has been collected. California is their nearest continental land, being 2100 miles distant, while Samoa and Fiji are 30°–40° S. and Tahiti is still further away, intervening islands being mostly of coral-reef origin. These groups are not sufficiently well-known to make a comparison with their fauna of much value, but Fiji is usually regarded as continental. The islands of Hawaiia are of volcanic origin and vary up to 14,000 feet in height. They present great diversities of climate, some coastal parts subtropical, the mountain summits snow-capped in winter, some parts relatively dry, even parched up, and others with more than 200 inches of rain. Probably all was at one time covered with forest, relatively tropical by the coasts, dense rain-forest above, more open on the much drier higher slopes. Most of the lower forest has long been cleared away, but parts of the rain-forest persist as well as great stretches of the higher woods.

The fauna may be said to be a function of the flora, and this flora has only 860 known species, of which 653 are endemic with 40 endemic genera, the rest being introduced weeds or common littoral forms. Geographically this flora must take precedence, for the first animals must not only be able to land, but to find suitable vegetation on which to feed. These animals must flourish or carnivorous beasts will never become regular components of the fauna. Again, most immigrants to oceanic islands must be supposed to be best adapted to the conditions of the low country, where later man's ravages by axe and fire will be most felt. In any case most of those that survive the passage will be unproductive, since, even if they do find suitable climate and food, few indeed will find mates.

For a small insect to become widespread round the coast of one of these islands would take many generations. A still longer time would be required to take each step up the mountains, because either each step would mean the adaptation of the needs of the animal to fresh environments, resulting later in the production of new forms, or each step would be taken as the result of some variant of its physical organisation resulting in a new need. Each beast in each step must take a mate with him, and the time required for

[1] "Fauna Hawaiiensis; or, the Zoology of the Sandwich (Hawaiian) Isles.' Being Results of the Explorations instituted by the Joint Committee appointed by the Royal Society of London for Promoting Natural Knowledge and the British Association for the Advancement of Science, and carried on with the assistance of those Bodies and of the Trustees of the Bernice Pauahi Bishop Museum at Honolulu. In three volumes. Edited by David Sharp, F.R.S. (Cambridge University Press.)

the production of new forms by either physiological or morphological variation becomes still more considerable.

Dr. Perkins, and apparently all the contributors to the "Fauna" agree that Hawaiia is oceanic. Dr. Perkins summarises the evidence in his "Review of the Land-Fauna," the last published part. He further points out that nineteen-twentieths of the endemic species are found in the forest belt. This is in accordance with theory, for the isolation as varieties leave the coast land is to be expected to be helpful to species formation, though the largeness of the proportion is doubtless helped by the destruction of the lowland vegetation. The inconspicuousness of the fauna and flowers is noted, but the paucity of individuals—some parts are barren to the collector owing to the devastation of carnivorous ants—is doubted, as is interbreeding as producing diminished fertility. 3325 species of insects are known, and practically all the endemic species are of small size and special habits; many are flightless. Their large amount of variability is interesting as well as a distinct tendency to specialisation in variation in different localities.

Dr. Perkins clearly considers that the fauna arose from a very few immigrants, which have varied to form the present large genera and groups of allied genera. Some genera are confined to one of the six forest-clad islands, and in large genera few species from different islands are identical. Isolation even without selection is supposed to have brought about change, and the extreme difficulty that the systematist has in limiting his species is ascribed to the absence of agencies by which natural selection works. On every theoretical point Dr. Perkins has some fertile suggestion, but the writer hesitates to quote more because such might be misconceived by the reader, who had not the altogether unique facts before him.

J. STANLEY GARDINER.

SIR W. N. HARTLEY, F.R.S.

By the death of Sir Walter Noel Hartley, the scientific world has lost a man who undoubtedly has enriched it in very many ways. Although perhaps his name is more intimately connected with work upon absorption spectra and their relation to the constitution of organic compounds, yet Hartley also carried out most important investigations in many other branches of spectroscopy.

Sir Walter Hartley was born on February 2, 1846, and was appointed professor of chemistry in the Royal College of Science, Dublin, in 1879, a position he held until his retirement under Civil Service regulations in 1911. One of the founders of the Institute of Chemistry, he was a vice-president from 1900 to 1903. He was elected a Fellow of the Royal Society in 1884, and was awarded the Longstaff medal by the Chemical Society in 1906. He received his knighthood on the occasion of the opening of the new buildings of the Royal College of Science, Dublin, by the King and Queen in 1911. His death, which occurred on September 11, at Braemar, was due to heart failure following on bronchitis.

Hartley's investigations were almost entirely connected with spectroscopy, and his published papers deal with three of its principal branches, namely, flame spectra, spark spectra, and absorption spectra. Perhaps the most striking thing in connection with all his work is the singular interest which he instilled into it. To many, spectroscopy may appear as a somewhat dry statistical study of the wave-lengths of emission lines and absorption bands, but no one on reading Hartley's numerous and varied contributions to the literature of the subject could lay such an accusation against his work. There is to be found there no mere dull compilation of accurate measurements, but copious evidence of wonderful insight and keenness. In all his work, Hartley showed himself a pioneer in the application of spectroscopic methods to the study of the nature and properties of the chemical atom and molecule, and it is from this that the great interest of his work arises.

In 1872 Hartley became the possessor of Dr. W. A. Miller's spectroscope, and he not only showed that it was possible to obtain the whole spectrum in focus upon a flat plate with the use of quartz prisms and unachromatised quartz lenses, but he was the first to use dry plates in the photography of spectra. The original apparatus was modified considerably, and amongst other improvements it was so devised that a number of photographs could be taken on the same plate This in itself marked a great advance in technique. Hartley in the early days almost entirely restricted himself to the use and study of spark spectra. In 1883 he published a series of photographs of spark spectra, and in 1884 he put forward, in conjunction with Dr. W. E. Adeney the wave-lengths of the lines in these spectra. This later paper also contained the wave-lengths of the lines due to air which are of such importance in all spark spectra observations. The publication of these wave-lengths marked a very important advance in spectroscopy.

Later, Hartley turned his attention to the spark spectra of solutions of metallic salts, and it is to him that we owe almost the whole of our knowledge of the nature and character of the lines in these spectra. From a study of the effect of concentration it was soon noted that all the lines do not disappear at the same dilution. Hartley found that there exists a constant relation between the dilution and the appearance or disappearance of certain lines of each metal, and based on this he was able to found a system of quantitative analysis. The value of this method he proved by applying it with perfect success to the analysis of an Egyptian coin. Similarly, from his knowledge of the relative persistence of spectrum lines, he was the first to prove the presence of gallium in the sun and many of the stars. In the same way he showed the remarkably extensive distribution of the rare earth metals, and also the great prevalence of lithium in very small quantities. He pointed out that the latter fact is of considerable interest with reference to recent work on radioactivity.

Again, Hartley was the first to discover the relation between the wave-lengths of lines in the spectra of analogous elements. He explained the fact by saying that analogous elements do not consist of different kinds of matter, but of different quantities of the same kind of matter. This relation possesses a fundamental significance in connection with modern views on the electronic nature of the atom; and, moreover, the deduction Hartley himself made affords support to the theories recently put forward as to the evolution of the elements.

In his work on flame spectra, Hartley showed the value of the oxy-hydrogen flame. In conjunction with Dr. H. Ramage, he discovered the existence of the bands in the flame spectra of many metals, and from a study of these he was able to draw important conclusions about the relation between the band and line spectra of the same element. Further, both alone and with Ramage, he made an exhaustive study of the spectroscopy of the Bessemer process, and was able to contribute largely to the knowledge of the thermochemistry of that process.

With Hartley's work on absorption spectra it is not possible adequately to deal in a brief epitome. In this direction he has undoubtedly founded a field of research which is of great importance and promise, as Prof. von Baeyer has recognised. Hartley was the first to establish a scientific method of observation and recording of absorption spectra, and was the first to show that they may be applied to the problems of chemical constitution. In a series of nearly fifty papers he dealt with the absorption exerted by both inorganic and organic compounds. In the first-named, he showed how the spectroscopic evidence was antagonistic to the ionic hypothesis in its earlier development. In the second, he showed, among many other fundamentally important facts, that the colour of all dyestuffs and similar compounds is to be traced to the absorptive power of the hydrocarbons from which they are derived. In fact, he gave the scientific explanation of the chromophore theory. Also may be mentioned his investigation of the absorption exerted by the alkaloids, and his record of facts that are of great importance to the synthetic chemist, and also from the medico-legal point of view. The application of the method to the elucidation of the constitution of carbostyril, *o*-oxycarbanil, isatin, and other compounds is perhaps too well known to need emphasis. It is impossible to specify the many lines of work Hartley successfully carried on in absorption spectra. He has left accurate records of the absorption curves of a vast number of substances, and he discovered a series of fundamental laws governing the relation between absorption and chemical constitution with which his name always will be associated.

In conclusion, it may well be said of Hartley that whatever research he undertook, his results were always most valuable, and he conferred distinction upon everything to which he put his hand.

E. C. C. B.

DR. ALEXANDER MACFARLANE.

DR. ALEXANDER MACFARLANE, whose name is well known to workers in vector algebras, died at his home in Chatham, Ontario, on August 28. He was born in Blairgowrie on April 21, 1851, and was trained as a pupil teacher. As a student in Edinburgh University he soon impressed his contemporaries with his mental capacity. He gained high distinctions in the class of logic and philosophy as well as in mathematics and natural philosophy. After graduating with first class mathematical honours, he proceeded to study for the science degree, gaining his doctorate in 1878 with a thesis on the conditions governing the sparking of electricity between electrodes in air and in paraffin. The experimental work was carried out in Prof. Tait's laboratory, but the idea of the research was entirely Dr. Macfarlane's own. Some of these early results are referred to by Clerk Maxwell in his "Electricity and Magnetism."

Dr. Macfarlane did not, however, pursue experimental research, but turned his mind to the application of mathematical symbols in somewhat unusual directions. His "Algebra of Logic" was published in the late 'seventies, and he read before the Royal Society of Edinburgh a series of papers on the algebra of the relationships of consanguinity and affinity. In 1885 he was appointed professor of physics in Texas University, and was of great service in developing that institution as a centre of scientific teaching. About this time he published a book on physical arithmetic, which was the first sustained systematic treatment of methods of calculation useful in physical reductions. He was also the compiler of a compact and well-arranged book of mathematical tables.

He retired from active teaching in 1894, and some years later settled in Canada on a large farm which had been bequeathed to him by an uncle. Here and subsequently in the neighbouring town of Chatham, he turned his attention to the study of vector algebras. Already he had taken part in the controversy which appeared in NATURE (1893–4) as to the rival merits of quaternionic and non-quaternionic vector analysis. Prof. Tait, Prof. Willard Gibbs, and Dr. Heaviside were among the disputants. Dr. Macfarlane agreed with none of these, but took a line of his own, which he has worked out with ingenuity in many later papers. Last year, for example, he read a short paper on the subject before the Mathematical Congress at Cambridge. It was, however, as the devoted secretary of the Association for the Study of Quaternions and Allied Systems of Mathematics that he found his chief opportunity. This association, which was started by Dr. Kimura, of Japan, is now a fairly strong body of mathematicians representing all countries of the civilised world. Much of the success attending its labours must be attributed to the zeal and energy of the secretary, whose last letter to me, written just a fortnight before his death, anticipated a new departure which would increase the efficiency of the association.

Throughout his life Dr. Macfarlane was keenly interested in educational methods, and at the time of his death was Chairman of the Board of Education in Chatham, Ontario. C. G. KNOTT.

DR. JULIUS LEWKOWITSCH.

WE regret to announce that Dr. Julius Lewkowitsch, the well-known authority on fats and oils, died at Chamonix on September 16, after a short illness. He was born at Ostrovo, in Prussian Silesia in 1857, and had a brilliant university career at Breslau. After graduating as doctor of philosophy at Breslau, Lewkowitsch devoted himself to an academic career; he carried out a considerable quantity of original investigation under Prof. Victor von Richter at Breslau, and subsequently took a position under Prof. Hans Landolt in the chemical laboratory of the Berlin Agricultural High School. At a later date he became assistant to Prof. Victor von Meyer in the University of Heidelberg.

Lewkowitch's first published work consisted in the study of the action of nitric acid on fatty acids, but he soon applied himself to experimental work on stereochemistry, which was at that time a new and undeveloped subject, and was far from assuming the commanding position which it now holds. He was the first to develop the method given by Pasteur for the resolution of externally compensated substances by the action of living organisms, and in 1882 and 1883 prepared the optically active modifications of tartaric, lactic, glyceric, and mandelic acids from the corresponding racemic substances by the action of penicillium glaucum, aspergillus mucor, yeasts, and a schizomycetes. At a later date he attacked the problem presented by the optical inactivity of benzene derivatives, and made many experimental attempts to obtain such substances in optically active modifications.

The brilliance of Lewkowitsch's early experimental work indicates that, had he continued to devote himself to pure science, he would rapidly have achieved a foremost place as a teacher and investigator. About twenty-five years ago, however, he came to this country, became naturalised, and, abandoning his aspirations towards a purely scientific career, entered upon what proved to be his life-work, the development of the industrial technology of fats and oils. At the time of his death he was the first living authority on the vegetable and animal fats and oils; a large number of processes which are widely employed in the utilisation and valuation of these important raw materials were devised by him. His treatise on the "Chemical Technology and Analysis of Oils and Fats" is now in its fifth English edition, and has been published also in French and German; his "Laboratory Companion to Fats and Oils Industries" has a wide sphere of usefulness in English and in its German translation. Lewkowitsch wrote the article on oils and fats in the "Encyclopædia Britannica" and the articles on oils in the last and the current editions of Thorpe's "Dictionary of Applied Chemistry"; his writings on his own subject have set a standard of precise treatment which has been accepted and adopted in later works by others upon this great branch of chemical industry.

Dr. Lewkowitsch served in many capacities upon the Councils of the Chemical Society, the Society of Chemical Industry, the Institute of Chemistry, and the Society of Public Analysts; at the time of his death he was the honorary foreign secretary of the Society of Chemical Industry, and had held the chairmanship of the London Section of the society. In 1909 he received the Lavoisier medal as conférencier of the Société chimique de France; as a Cantor lecturer of the Royal Society of Arts he delivered a course of lectures on fats and oils which, in their published form, are of considerable value, and exhibit the great mastery which he had acquired over our language.

Lewkowitsch was a keen mountaineer; few men possessed so intimate and complete a knowledge as he had gained of the French and Swiss Alps, in sight of which he passed away. He married in 1902, and his widow, with a son and daughter, survives him. W. J. P.

NOTES.

DR. ROUX, director of the Paris Pasteur Institute, has been made a grand officer of the Legion of Honour.

THE death occurred on September 15, at the age of fifty-nine, of Dr. Louis Merck, senior partner of the firm of E. Merck, Darmstadt.

IT is stated in *The Lancet* that Mr. W. F. Fiske has been asked by the Tropical Diseases Committee of the Royal Society to investigate the life-history of the tsetse flies in Uganda.

THE *Chemist and Druggist* for September 20 contains the reproduction of a photograph of the bronze statue of Dr. Ludwig Mond, which was unveiled by Sir John Brunner, Bart., on September 13, and was alluded to in our issue of September 11 (p. 48).

THE death is reported, in his sixty-eighth year, of Prof. Lucien A. Wait. On graduating at Harvard in 1870 he was appointed assistant professor of mathematics at Cornell University. In 1877 he became associate professor, and in 1890 full professor. From 1895 to 1910 he was head of the department of mathematics.

ACCORDING to *Science*, a national museum is to be established in the city of Santo Domingo for the purpose of retaining and preserving in the country objects and relics of historical character connected with the discovery and development of the country.

The museum is to occupy the old palace known as the house of Don Diego Colon. The sum of 20,000 dollars has been appropriated by the National Congress for repairing the building.

THERE is no doubt as to the efficiency of the radium emanations in the cure of certain forms of superficial cancer, ulcers, &c. It is now stated that the emanations of mesothorium, derived from the waste in the manufacture of incandescent gas mantles, possess similar properties, but in an enhanced degree, and efforts are being made to prepare a sufficient supply of the material so that a thorough trial of it may be made.

WE notice with regret the death, on September 18, at eighty-five years of age, of Mr. Samuel Roberts, F.R.S., president of the London Mathematical Society from 1880 to 1882, and De Morgan medallist in 1896. Another well-known mathematician whose death, on September 19, is announced is Mr. John Greaves, bursar and senior mathematical lecturer at Christ's College, Cambridge, and author of "A Treatise on Elementary Statics."

THE death is announced, at the age of sixty-seven, of the eminent French surgeon, Prof. Antonin Poncet, who in 1882 was appointed to the chair of operative medicine at Lyons, and in 1895 was elected to the Academy of Medicine. He was the author of many medical works dealing with diseases of the bones, and was well known for his investigations into the cause of death of Napoleon, Richelieu, Rousseau, and many other famous men.

IT was briefly announced in our issue for September 11, that the importation into the United States of the plumage of wild birds, raw or manufactured, save for scientific or educational purposes, is by the new Tariff Bill prohibited. We now learn from Mr. W. T. Hornaday, of the New York Zoological Park, that the prohibition movement was inaugurated and carried through by the New York Zoological Society and the National Association of Audubon Societies. It would be well if their example were copied in this and other countries.

WE learn from *The Pioneer Mail* that Sir Aurel Stein, K.C.I.E., has been deputed by the Government of India, with the sanction of the Secretary of State, to resume his archæological and geographical explorations in Central Asia and westernmost China. For his journey to the border of Chinese Turkestan on the Pamirs Sir Aurel Stein is taking on this occasion a route which offers special interest to the student of the geography and history of the Hindu Kush regions. It leads through the Darel and Tangir territories which have not been previously visited by a European, and which only recent political developments have brought under British influence. The Survey of India Department has deputed with Sir Aurel Stein his old travel companion Rai Bahadur Lal Singh, and a second surveyor to assist him by topographical work.

As was announced in NATURE of September 11, the eminent entomologist, Dr. Odo Morannal Reuter, of Abo, Finland, Emeritus professor of zoology at Helsingfors University, died on September 2 in his sixty-fourth year. As an entomologist Prof. Reuter's name was known throughout the world as a leading authority on the Hemiptera-Heteroptera, whilst he was also a worker in the more obscure groups, the Collembola (spring-tails), Psocidæ and Thysanoptera (thrips). About five years ago it was learned from Prof. Sahlberg that his colleague, O. M. Reuter, had been sadly stricken with blindness, yet, despite this great affliction, he plodded on with the aid of a secretary, and shortly before his death a work—so written—on the habits and instincts of solitary insects saw light at Stockholm. His work was characteristically thorough, and though his contribution to zoological literature numbered about 480 publications, large and small, and included a number of works on animal psychology and practical entomology, he was also a writer on literary subjects and a poet of high attainments and merit. In this country he will be missed by many, and it is pleasing to know that the highest honour British entomologists can bestow—the honorary fellowship of the Entomological Society of London—was conferred upon him in 1906.

IN vol. iii. of the publications of the Babylonian section of the University Museum of Pennsylvania Mr. J. A. Montgomery contributes an elaborate memoir on a collection of Aramaic incantation texts from Nippur. These bowls were found above the stratum of the Parthian temple, which was destroyed and became covered with sand, and was occupied by small ascetic communities of Jews and Mandæans, probably attracted to this deserted place by motives of religious community life. They appear to date from approximately 600 A.D. The importance of the present discovery lies in the fact that this bowl magic is in part the lineal descendant of ancient Babylonian sorcery, while at the same time the unexpected result is arrived at that it takes its place in the great field of Hellenistic magic which pervaded the whole of the western world at the beginning of the Christian era. The monograph is a scholarly piece of work, and will be indispensable to all students of Oriental magic.

THE *Reading University College Review* for August, an attractive volume, includes an article on bovine tuberculosis in man, by Dr. Stenhouse Williams, which gives a good summary of the subject. He concludes that the bovine type of tubercle bacillus is the cause of one-third of the cases of tuberculous disease other than the pulmonary at ages 0–16 years, which corresponds to about 4000 deaths per annum in this country.

To the July-August issue of *Naturen* Mr. P. A. Øyen contributes an illustrated article on remains of the mammoth and the musk-ox in Norway, with a discussion as to the horizons in which they respectively occur.

WE have received a copy of a fifth edition of the late Mr. T. Southwell's admirable guide to the Norwich Castle Museum, brought up to date by Mr. F. Leney, the curator. Among the illustrations are figures of the stuffed skin and egg of the great auk, which form two of the chief treasures of the museum. To Prof. McIntosh we are indebted for a copy of a reprint of his sketch of the Natural History Museum of the University of St. Andrew's, originally published in the Museum's Journal.

ACCORDING to the report of the Madras Museum for the past year (issued by the Educational Department), a large collection of marine organisms has been obtained from the coral reef at Kilaharai, in the Ramnad district, the examination and classification of which are expected to occupy a considerable period. The superintendent also records the third or fourth specimen (it is not quite clear which) of the great snipe (*Gallinago major*) killed in India; all these appear to have been obtained since the publication, in 1898, of the fourth volume on birds in the "Fauna of British India," as the species is not mentioned in that work.

IN an article on the ancestry of Edentate mammals published in a recent issue of the American Museum Journal (vol. xii., pp. 300–303), Dr. Matthew, after mentioning that armadillos are probably the most primitive existing members of the group, and that "armadillos without armour" occur in the early N. American Tertiary, observes that although the latter and the tæniodonts of the N. American Eocene cannot be regarded as direct ancestors of the typical S. American edentates, yet they suggest the possibility that the group originally came from N. America, and penetrated to S. America about the beginning of the Tertiary, where it developed into a host of new forms.

GREAT interest attaches to the description by Dr. W. D. Matthew in vol. xxxii., art. 17 (pp. 307–314), of the Bulletin of the American Museum of Natural History, the imperfect skull of a new genus and species (*Palaeoryctes puercensis*) of the so-called zalamdodont insectivorous mammals from the Puerco, or Basal, Eocene of New Mexico. At the present day that group is represented by the Solenodontidæ of Haiti and Cuba, the Potamogalidæ of Equatorial (Dr. Matthew, judging from his map, seems to be unaware that the "otter-shrew" occurs in the eastern as well as in the western part of the forest-zone) and the Chrysochloridæ, or golden moles, of southern, eastern, and central Africa, and the Centetidæ, or tenrecs, of Madagascar. In 1891 the extinct genus Necrolestes, more or less nearly related to the Chrysochloridæ, was described from the Patagonian Miocene. At that time fossil forms were unknown from the northern hemisphere, which led to the suggestion that the group was essentially southern; but between 1903 and 1907 five extinct genera were recorded from the N. American Tertiary. The new genus now described serves to show the great antiquity of the tritubercular type of molar characteristic of the zalamdodonts; and also, if rightly associated with that family, indicates that the Centitidæ are the oldest existing group of placental mammals.

AMONGST the familiar sporozoan parasites known as gregarines, one genus, Porospora, has always stood apart from all others by reason of the possession of peculiar and anomalous characteristics. The genus comprises species parasitic in Crustacea, and *P. gigantea*, parasite of the lobster, is the largest gregarine known. Recent researches have shown that the peculiar "gymnospores," so-called, of these gregarines are not true spores at all, but clusters of merozoites, and that the apparent sporogony of these parasites in their crustacean hosts is really a process of non-sexual schizogony, different from that of all other gregarines. The question then arose: Where and under what circumstances does the true sporogony take place? The answer has now been given by the distinguished French investigators, Messrs. Léger and Duboscq, who have discovered that the sexual cycle and sporogony of Porospora takes place in bivalve molluscs, and is no other than that of the curious parasite described many years ago by Aimé Schneider under the generic name Nematopsis, a genus of which the systematic position has been hitherto quite uncertain. Thus *Porospora portunidarum*, parasitic in crabs, has its Nematopsis-phase in *Cardium edule*, the common cockle, in which host the parasite produces a single spore, containing a single vermiform sporozoite, in the gills of the mollusc. A preliminary account of the development of this species, illustrated by nineteen text-figures, is published in the *Comptes rendus des séances de la Société de Biologie* (vol. lxxv., p. 95).

WE have received the concluding numbers of the sixteenth volume (for 1912) of the *Bollettino* of the Italian Seismological Society. The complete volume contains eleven papers, the more important of which deal with the recent eruption of Etna, the luminous phenomena associated with the Valparaiso earthquake of 1906 (NATURE, vol. xc., p. 550), and the sea-waves of the Calabrian earthquake of 1907 (vol. xci., p. 327). The greater part of the volume, however, consists of the notices of earthquakes observed in Italy during the year 1909, compiled by Dr. G. Martinelli. These notices occupy more than six hundred pages, and their value has been increased by several improvements recently made. The constants of the seismographs used in twenty-nine Italian observatories are given in an appendix; the notices relating to different earthquakes are separated by a space (it would be still more useful if they were numbered); the earthquakes, with the exception of those recorded by a single instrument or from one place only, are named according to the districts chiefly affected by them, and of these an alphabetical index is added.

A RECENTLY issued Bulletin (No. 54) of the Bureau of American Ethnology, by Messrs. Hewett, Henderson, and Robbins, deals with the Rio Grande valley, an arid region in New Mexico. The bulletin contains three papers; the first two, on the physiography and general geology respectively, are more or less introductory to the third, which deals with the climate and climatic changes. The evidence for the latter is (1) archæological, (2) botanical, and (3) geological. (1) There are great numbers of ruins in the country, many of them far from present known sources of water, and even as late as the coming of the Spaniards the population seems to have been denser than now. (2) Study of the trees shows that the rock pine and the piñon pine are the most widespread, the latter occupying the drier situations. The boundary between these two species is shifting towards the moister regions, indicating that the area which is too dry for the rock pine to inhabit is increasing. (3) Geologically, the authors have to take a wider field. Of chief importance is the evidence that the whole of the south-west States have suffered a great diminution of their mountain glaciers and enclosed lakes, commencing several thousand years ago, and probably still in progress, as shown by measurements in the last few decades. No single line of evidence is conclusive, but the convergence of so many, coupled with the experience of observers in other lands, renders dessication in this region in human times very probable. In connection with the authors' suggestion for the careful measurement of the fluctuations of land-locked lakes, it may be noted that such records are now being kept in the British colonies in tropical Africa. The work is illustrated with a number of very clear photographs, but the omission of the names of the months and the scales of units in the diagrams of monthly rainfall and temperature is unfortunate.

We have received the "Pilot Chart" of the North Atlantic Ocean for September, published by the United States Hydrographic Office, containing similar useful information relating to winds, currents, &c., to that included in the "Meteorological Charts" formerly published by the Weather Bureau, but now discontinued (Nature, September 11). An interesting account is given of observations on ocean temperatures in the vicinity of icebergs and in other parts of the ocean by officers of the U.S. Bureau of Standards, with illustrations of the temperature equipment and of samples of the records obtained. Practically continuous temperature readings were obtained from June 4 to July 10, 1912, and these show that the variations in parts of the ocean far removed from ice are often as great and sudden as in the vicinity of icebergs. The authors consider that the question is still in doubt whether these influence to any considerable extent the temperature of sea-water at a mile or so distant.

An interesting article on evaporation in the great plains and intermountain districts as influenced by the haze of 1912, by Messrs. L. J. Briggs and J. O. Belz, of the Bureau of Plant Industry, appeared in the Journal of the Washington Academy of Sciences of August 19. The haze was presumably due to the eruption of Mount Katmai (Aleutian Islands) on June 6–7 of that year, during which volcanic ashes fell at Sitka, 700 miles distant, and the sun was obscured for a time. It gave rise to a marked diminution in the intensity of solar radiation, which was particularly noticed in subsequent months at the Mount Wilson, Mount Weather, and Madison observatories in the United States. The authors, who had been engaged in evaporation measurements during the last five years, deemed it desirable to determine to what extent this reduction of solar intensity affected the evaporation (not forgetting that this is also greatly influenced by other factors). Tables of monthly normal evaporation for fifteen stations show that during four months following the eruption the average reduction was about 10 per cent. This reduction in the mean evaporation, although somewhat less than the observed reduction in solar intensity, appears to afford an approximate measure of the reduction of the latter at the earth's surface.

The *Scientific American* (vol. cix., No. 5) contains two illustrated articles on the modern developments of the electric furnace. In the first (p. 84) an account is given of recent patents covering improvements in the electric arc as used in the purification of steel and iron and in the production of compounds of nitrogen from the air; whilst in the second a special account is given of the electrical production of steel, from the early experiments of Siemens to the thirty-ton furnace of to-day. Illustrations are given of the Stassano arc furnace in use at Turin, of the Kjellin and the Röchling-Rodenhausen induction furnaces, and of the Heroult 15-ton arc furnace in use at the works of the U.S. Steel Corporation.

Aëronautical science in America receives fresh recognition in the decision of the Smithsonian Institution to reopen the Langley Aërodynamical Laboratory. The first serious contribution from the scientific side of aëronautics is to be found in the work of Langley, the necessary funds being provided by a Governmental grant; had the light petrol motor come into existence twenty years ago, it is probable that the Langley Laboratory would never have been closed, and would now be the leading aëronautical laboratory in the world. The Smithsonian Institution is a private concern, although closely connected with the U.S. Government departments. For the present it will be dependent on private donations for its income for aëronautical research, though in time it is hoped to receive a Governmental grant in aid. Apparatus useful in aëronautics already exists in the U.S. Bureau of Standards, and the U.S. Weather Bureau, with which the Langley Laboratory will be closely connected, and financial support is primarily needed for the construction of two wind tunnels and the necessary model-making apparatus. In addition to experiments on models an aircraft field laboratory is proposed, for measurements of stress, moments of inertia, &c., and for the adjustment and repair of several full-scale land and water aëroplanes.

In the July number of *The Biochemical Journal* (vol. vii., No. 4) Mr. Egerton C. Grey demonstrates the production of acetaldehyde during the anaerobic fermentation of glucose by *Bacillus coli communis*, and states that, by artificial selection by means of growth on sodium chloracetate, strains of the original organism can be obtained which produce either a greatly diminished amount of the aldehyde or none at all. As this diminution is accompanied by a falling-off of the production of alcohol and carbon dioxide, it is probable that the aldehyde is a primary, not a secondary, product of fermentation, and that the process of alcohol formation by *B. coli communis* is analogous to the alcoholic fermentation set up by the zymase of yeast.

In the current number of the *Berichte* (No. 11, p. 2401), Prof. Willstätter and L. Zechmeister publish an important communication on the quantitative conversion of cellulose into dextrose by means of cold, fuming hydrochloric acid of sp. gr. 1·204° to 1·212°, containing from 40 to 41·4 per cent. of hydrogen chloride. A problem has thus been solved which for more than one hundred years has been vainly attempted by the use of hot mineral acids and other means. Although ordinary concentrated hydrochloric acid containing 37·6 per cent. of hydrogen chloride does not dissolve cellulose but merely disintegrates the fibre and causes gelatinisation, the more concentrated acid containing 40 per cent. rapidly dissolves it, and after twenty-four to forty-eight hours 95 to 96 per cent. of the theoretical quantity of dextrose is present in the solution. The course of the hydrolysis has been followed by observing the specific rotatory power and copper-reducing value of the solution in successive intervals of time. In this way it was found that the cellulose at first dissolves in an optically inactive form, thus differing entirely from starch, which gives a highly dextro-rotatory modification from the start. Only after one hour is a slight dextro-rotation to be observed, which progressively increases; in the early stages the product, which can be precipitated from solution by water or alcohol, is of a dextrin-like character, but without either reducing power or specific rotation. The solution gradually develops reducing properties as the specific rotation increases, but during the first six hours the amount of "dextrose" calculated from the reducing power is much less than that calculated from the change of rotation. It is thus probable that a complex, optically active, but non-reducing sugar is formed first, and that this is later further resolved into dextrose. One of the most striking observations recorded in the paper is the very high specific rotation shown by dextrose when dissolved in concentrated hydrochloric acid. In 41·4 per cent. hydrochloric acid $[\alpha]_D^{16°}$ was found to be 106°, which approximates to that of the so-called α-form of dextrose (110°), the ordinary value observed in aqueous solution for the equilibrium mixture of α- and β-forms being 52·5°. In 44·5 per cent. hydrochloric acid, however, the extraordinarily high value of 164·6° was observed for $[\alpha]_D$ at 5° C.

No. 29 of *Scientia* contains a number of articles of general scientific interest. Dr. E. E. Fournier d'Albe writes on interstellar space, Dr. A. Findlay gives a short account of the phase rule and its applications, and Mr. Léon Fredericq contributes an interesting summary of the methods by which animals utilise chemical and physical forces as means of defence. Mr. E. Rignano discusses the problem of the evolution of reason, and G. Cardinali traces the influence of Hellenic culture on the development of Roman civilisation.

OUR ASTRONOMICAL COLUMN.

VARIABLE NEBULÆ.—M. Borrelly's recent announcement in the *Comptes rendus* that Hind's nebula appeared to be passing through a period of maximum is now followed (No. 9, *Comptes rendus*) by a note from M. G. Bigourdan incorporating a list of the dates of published measures together with the names of the observers dating from Schönfield's observations, July 26, 1861. Attention is directed to the importance of confirming M. Borrelly's observation.

COMET (1913*b*) METCALF.—The following is the ephemeris of Metcalf's comet as taken from the *Astronomische Nachrichten*, No. 4682:—

12h. M.T. Berlin.

	R.A. h. m. s.	Dec. ° ′	Mag.
Sept. 25	3 41 54	+76 44·2	—
26	3 6 0	77 17·7	—
27	2 25 33	77 31·4	8·4
28	1 42 38	77 16·6	—
29	1 0 15	76 40·9	—
30	0 21 36	75 33·3	—
Oct. 1	23 47 1	74 1·0	8·2
2	23 18 26	72 6·0	—

The above ephemeris has been calculated by Prof. Kobold from the observations on September 2, 6, and 10, which gives quite a new set of parabolic elements and makes the places of the comet very different from those calculated from his previous elements.

The present elements are as follows:—

T = 1913 Sept. 13·9168 M.T. Berlin.

$$\left.\begin{aligned}\omega &= 117^\circ\ 7'\ 51''\\ \Omega &= 157^\circ\ 9'\ 59''\\ i &= 143^\circ\ 24'\ 25''\end{aligned}\right\}1913{\cdot}0.$$

$\log q = 0{\cdot}133805$

As this comet is getting brighter and higher up in the sky, it should be observable with telescopes of small aperture.

COMET 1913*c* (NEUJMIN).—This comet, discovered by Neujmin, is becoming fainter, being now nearly of the 12th magnitude. For the sake of those who wish to follow it further with larger telescopes, the following ephemeris by Herr M. Ebell, taken from a supplement to the *Astronomische Nachrichten*, No. 4680, is given:—

12h. M.T. Berlin.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Sept. 25	23 39 58	+6 4·7	11·8
,, 26	23 39 35	6 18·8	
,, 27	23 39 14	6 32·4	
,, 28	23 38 54	6 45·4	
,, 29	23 38 36	6 57·9	
,, 30	23 38 19	7 10·0	
Oct. 1	23 38 3	7 21·6	
,, 2	23 37 49	7 32·7	12·1

ANNALS OF THE BUREAU OF LONGITUDES.—Containing accounts of the inception, organisation, programmes, and transactions of two international conferences which have led to results of the highest practical importance in applied astronomy, the ninth volume of the Annals of the Bureau of Longitudes attains the distinction of being not only a valuable document in the history of that science, but also of marking a stage in the growth of international cooperation in scientific work. Of the successful issue of the Congrès des Ephémérides, let us recall only the sixth of the seven general resolutions adopted, namely, that the names of stars should be accompanied by designations of their spectral type after the notations of Pickering. The work last autumn of the Conférence Internationale de l'Heure, of course, chiefly centred around the employment of wireless telegraphy not only in the distribution of time, but also in the service of meteorology. The value of these applications is attested both by the rapidly increasing numbers using the time-signals, especially on land, and by the fact that it has recently been found necessary to add more than a dozen stations to the original six for which the meteorological elements were distributed on the resolution of the conference.

In addition to the reports just mentioned, the volume also contains a detailed account of the determination by wireless telegraphy of the difference in longitude between Paris and Bizerta.

SPECTRUM OF WOLF-RAYET STAR D.M. $+30°$ 3639.—Mr. Paul W. Merrill records in the Lick Bulletin, No. 230, the result of the examination of the red end of the spectrum of the Wolf-Rayet star D.M. $+30°$ 3639, the photographic magnitude of which is 10·0, and position for 1900·0 R.A. 19h. 30m. 8s., Dec. $+30°$ 18′. The following previously observed bright lines appear:—λ4652 broad; $H\beta$ monochromatic, strong; λ5694 broad; λ581 broad, trace; D_3 doubtful; $H\alpha$ monochromatic, strong. In addition to the above, the following two bright lines appear:—λ6548·5 monochromatic, 0·4 as strong as $H\alpha$; λ6583·4 monochromatic, slightly stronger than $H\alpha$. The chief nebular lines are not seen in the star's spectrum. It is pointed out that these two nebular lines were observed by Wright in the nebula N.G.C. 7027, but are otherwise unidentified. While the two lines appear together it does not necessarily follow that their origins are identical.

THE BERLIN MEETING OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION.

THE meeting of the International Electrotechnical Commission was held in Berlin at the Kunstlerhaus from September 1 to September 6. It was well attended, twenty-four nations being represented by seventy delegates. In addition to the voting delegates sent by the local committees of the countries represented, some of the Governments also nominated their official representatives, those representing England being Dr. Glazebrook, who was unfortunately not able to attend, Dr. Gisbert Kapp, Dr. Silvanus P. Thompson, and Mr. Duddell, the president of the Institution of Electrical Engineers. The German Government was represented by Dr. Jaegar, Geheimrat Dr. Strecker, and several others. Unfortunately, Dr. E. Budde, the president of the International Electrotechnical Commission, was absent through illness, but his place was very efficiently filled by Dr. Warburg, the president of the Reichsanstalt.

The commission was welcomed on behalf of the German Government by Dr. Lewald, Director of the Ministry of the Interior. Prof. Paul Janet, of the Laboratoire Centrale, Paris, replied on behalf of the commission.

The proceedings were opened by the reading of the report of the honorary secretary, Col. Crompton, on the work which had been accomplished up to date and confirmed by the last plenary meetings held two years previously at Brussels; he also briefly described the new work which had been prepared during the two years' interval by the various national committees, and by the four special committees which had been appointed to bring forward the four main subjects requiring international treatment; and which required confirmation at this the second plenary meeting, to ensure final acceptance by all the national committees.

The first two days were occupied by the final meetings of the special committees. The first, and certainly the most difficult, question to be decided internationally, was that of providing a means of international rating of electrical machinery. This matter, touching closely as it does on industrial questions, was naturally very warmly debated, both in the meetings of the special committee, which was presided over by Huber Stockar, the well-known Swiss engineer, and at the full meeting, but although much valuable evidence was brought forward on the test methods to be adopted for international rating, the only figures that were unanimously agreed to were the final temperatures permissible in the hottest parts of working generators, motors, and transformers, but the remaining very necessary factors, namely agreement as to temperature-rise and as to the standard temperature of the ambient air from which the temperature-rise must be calculated, were not considered to be sufficiently settled to allow of unanimity.

On the latter point the English and American engineers insisted on taking the ambient air temperature at a figure of 40° C., which is very frequently obtained at certain times of the year in all tropical and in many temperate climates, especially in engine-rooms, stokeholds, and similar places. It will be noted that the choice of this high temperature is greatly to the advantage of a purchaser, as it ensures that a machine ordered on standard international rating will be a somewhat large machine capable of a larger overload in cool weather than was hitherto considered necessary by manufacturers. The majority of the meeting was apparently in favour of adopting this high figure so favourable to the consumer; but the German and Swedish engineers thought that the matter was too important to be decided off-hand, so the filling in of these two figures is left for further consideration by the national committees. It is hoped that an agreement may be arrived at in the course of this year, or at any rate before the next plenary meeting, which is to be held at San Francisco two years hence.

The reports and the recommendations of the three other special committees, first that on nomenclature, second on the international standardisation of symbols in use for formulæ, and third on the definitions and terminology for prime-movers used for electrical generating plant, were all unanimously adopted. It is needless to point out that the unification of symbols is of immense benefit to the engineering student, and the unanimity arrived at by a number of delegates who, in the majority of cases, are largely interested in other branches, and particularly mechanical engineering, makes it probable that this unification of symbols will extend to all branches of engineering science, and perhaps eventually to all branches of physical investigation.

As regards nomenclature, although the work done is undoubtedly good and useful, at first sight it seems small in amount, as a list of only eighty terms with the expressions defining them was adopted. It has been found necessary to modify the original arrangements by which there should be two official languages, English and French, to which others should be referred, but the inconvenience of having two languages of reference was so marked that the English agreed to forego their claim that English should continue to be one of the official languages, French now remains as the one language of reference from which all words and expressions must be translated, but it was decided that the vocabulary which has now been prepared should contain the official corresponding words now agreed to, in four languages—French, English, German, and Spanish. The delegates from five countries using the Spanish language informed the meeting that this unification of terms in the Spanish language would be of great service to them, for already misunderstandings had arisen, as some of the South American countries using the Spanish language had shown a tendency to adopt different Spanish words for one and the same expression.

Another matter satisfactorily settled was the copper standard, which had long been discussed between the four National Physical Laboratories of England, France, Germany, and America, and the ultimate figures were agreed to, so that the tables of copper conductors based on this standard will be common to all the countries.

Mr. Maurice Leblanc, of Paris, was unanimously elected to succeed Dr. Budde, as president of the I.E.C., for a term of two years, and he will therefore preside at San Francisco.

Colonel Crompton was re-elected honorary secretary for the third time.

The Spanish delegates invited the special committees to hold their next meetings in April next in Madrid, and the Russian delegate, Prof. de Chatelain, on behalf of the Russian Committee, invited the I.E.C. to hold the plenary meeting of 1917 in St. Petersburg.

BUDGETS OF CERTAIN UNIVERSITIES AND UNIVERSITY COLLEGES IN ENGLAND AND WALES.

THE reports for the year 1911–12 from those universities and university colleges in Great Britain which are in receipt of grant from the Board of Education have been issued in two bulky volumes (Cd. 7008 and Cd. 7009). The first volume contains reports from the provincial universities and university colleges in England, and the second reports from the London college, including the medical schools, the Welsh colleges, and Dundee University College.

The tabular matter which precedes the separate reports from the various universities contains detailed information as to the income and expenditure of the places of higher education concerned. The following summaries have been compiled from the tables, and show at a glance the amount available for education and research in the universities and colleges receiving Treasury grants and how the income is expended.

UNIVERSITIES AND UNIVERSITY COLLEGES.

(1) ENGLAND.

(*a*) *Income.*

	Amount £	Percentage of total
Fees	180,371	29·0
Endowments	85,435	13·7
Donations and Subscriptions	22,437	3·6
Annual Grants from Local Authorities	95,875	15·4
Parliamentary Grants	215,003	34·5
Contributions from Hospitals, &c., for services rendered	659	0·1
Other Income	22,694	3·7
Total	622,474	100·0

(*b*) *Expenditure.*

	Amount £	Percentage of total
Administration	64,528	10·7
Provision and Alteration of Buildings	6,785	1·1
Maintenance	63,714	10·6
Educational Expenses	400,001	66·4
Superannuation	13,575	2·3
Scholarships, &c., from sources other than Trust Funds	9,187	1·5
Other Expenses	44,228	7·4
Total	602,028	100·0

(2) WALES.

(*a*) *Income.*

	Amount £	Percentage of total
Fees	18,117	28·2
Endowments	4,191	6·5
Donations and Subscriptions	1,911	3·0
Annual Grants from Local Authorities	5,283	8·2
Parliamentary Grants	33,805	52·7
Other Income	890	1·4
Total	64,197	100·0

(*b*) *Expenditure.*

	Amount £	Percentage of total
Administration	8,104	12·7
Maintenance	4,659	7·3
Educational Expenses	46,399	72·6
Superannuation	1,640	2·6
Scholarships, &c., from other than Trust Funds	395	0·6
Other Expenses	2,670	4·2
Total	63,867	100·0

The total income from endowments in England has increased by about 4500*l.*, due chiefly to new endowments for Reading University College, which bring in about 4000*l.* a year, and the increased income of about 1600*l.* a year available for East London College. On the other hand, the income from Welsh endowments has fallen by nearly 300*l.* The total income from donations and subscriptions shows some falling-off, both in England and Wales, owing in part at least to the exclusion of donations specially earmarked for scholarship purposes. The net annual grants from local education authorities show an increase of about 10,000*l.* in England and about 800*l.* in Wales. The income received from Parliamentary grants increased during the year by about 58,000*l.*

The expenditure during 1911–12 out of income upon the provision and alteration of buildings in England was more than 4000*l.* greater than in the previous year, owing in the main to heavy expenses at Leeds largely due to the provision of a hostel for women and to alterations and equipment at University College, London.

THE PILTDOWN SKULL.

IN his evening lecture to the British Association at Birmingham on September 16, Dr. Smith Woodward took the opportunity of replying to Prof. Arthur Keith's recent criticisms on his reconstruction of the Piltdown skull. It will be remembered that Dr. Woodward regarded the mandible as essentially that of an ape, and restored it with ape-like front teeth, while he determined the brain-capacity of the skull to approach closely the lowest human limit. Prof. Keith, on the other hand, modified the curves of the mandible to accommodate typically human teeth, and reconstructed the skull with a brain-capacity exceeding that of the average civilised European.

Fortunately, Mr. Charles Dawson has continued his diggings at Piltdown this summer with some success, and on August 30, Father P. Teilhard, who was working with him, picked up the canine tooth which obviously belongs to the half of the mandible originally discovered. This tooth corresponds exactly in shape with the lower canine of an ape, and its worn face shows that it worked upon the upper canine in the true ape fashion. It only differs from the canine of Dr. Woodward's published restoration in being slightly smaller, more pointed, and a little more upright in the mouth. Hence, there seems now to be definite proof that the front teeth of Eoanthropus resembled those of an ape, and its recognition as a genus distinct from Homo is apparently justified.

The association of such a mandible with a skull of large brain-capacity is considered by Dr. Woodward most improbable, and he has made further studies of the brain-case with the help of Mr. W. P. Pycraft, who has attempted a careful reconstruction of the missing base. Dr. Woodward now concludes that the only alteration necessary in his original model is a very slight widening of the back of the parietal region to remedy a defect which was pointed out to him by Prof. Elliot Smith when he first studied the brain-cast. The capacity of the brain-case thus remains much the same as he originally stated, and he maintains that Prof. Keith has arrived at a different result by failing to recognise the mark of the superior longitudinal sinus on the frontal region and by unduly widening that on the parietal region.

It is understood that Mr. Dawson and Dr. Woodward will offer an account of the season's work to the Geological Society at an early meeting, and Prof. Elliot Smith will include a detailed study of the brain-cast of Eoanthropus in a memoir on primitive human brains which he is preparing for the Royal Society.

THE BRITISH ASSOCIATION AT BIRMINGHAM.

SECTION C.

GEOLOGY.

Opening Address by Prof. E. J. Garwood, President of the Section.

On the last occasion when members of the British Association met in Birmingham, in 1886, this section was under the able presidency of my friend Prof. T. G. Bonney, who at that time occupied the chair of geology at University College, London. Fifteen years later I succeeded him on his retirement from that post, and to-day I succeed him as president of this section, at the second meeting of the Association at Birmingham; and again I feel the same diffidence in following him as I did on the former occasion.

In his address in 1886 Prof. Bonney discussed the "Application of Microscopic Analysis to Discovering the Physical Geography of Bygone Ages."

Strangely enough, this title might apply almost equally well to the subject of my address to-day; but whereas Prof. Bonney employed for his purpose the evidence obtained from observations on mechanical sediments, I propose to deal with certain organically formed deposits with the same object

More than twenty years ago, whilst engaged in the study of the lower carboniferous rocks of Westmorland, I noticed the occurrence of certain small concretionary nodules of very compact texture, in the dolomites near the base of the succession in the neighbourhood of Shap.

Shortly afterwards, when examining the Bernician rocks of Northumberland, I again met with similar compact nodular structures. It was obvious, however, even at that time, that the Northumberland specimens occurred here at a much higher horizon than those which I had observed in Westmorland.

More recently, whilst studying the lithological characters of the lower carboniferous rocks of the North of England and the Border country, I have been still further impressed by the abundance of these nodular structures at several horizons, and the large tracts of country over which they extend. An examination of these nodules in thin sections showed their obvious organic character, and I was at first inclined to refer them to the Stromatoporoids. Dr. G. J. Hinde, who was kind enough to examine my specimens from the Shap district, reported, however, that they were probably not Stromatoporoids, but calcareous algæ, and referred me to the descriptions of Solenopora published by the late Prof. Nicholson and Dr. Brown.

Since then I have examined a large number of nodules collected from different horizons in the lower carboniferous rocks of Britain and Belgium; and the examination has convinced me that the remains of calcareous algæ play a very much more important part in the formation of these rocks than has hitherto been generally realised.

The majority of geologists in this country have been slow to recognise the importance of these interesting organisms, and, with the notable exception of Sir Archibald Geikie's text-book, we find but scant allusion in English geological works of reference to the important part played by calcareous algæ in the formation of limestone deposits.[1]

From the more strictly botanical standpoint, however, we are indebted to Prof. Seward for an admirable account of the forms recognised as belonging to this group, up to the date of the publication of his text-book on fossil plants in 1898; while in an article in *Science Progress,* in 1894, he has also dealt with their importance from a geological point of view.

Since these publications, not only have several new and important genera been discovered in this country and abroad, but the forms previously known have also been found to have a very much wider geological and geographical range than was formerly suspected. For these reasons I venture to hope that a summary of our knowledge of the part they play as rock builders, more especially in British deposits, will serve to stimulate an interest among geological workers in this country in these somewhat neglected organisms.

Previous to 1894, in which year Dr. Brown first referred Solenopora to the Nullipores, with the exception of the Jurassic and Tertiary Characeæ, we meet with little, if any, reference to the occurrence of fossil calcareous algæ in British deposits.

Indeed, in this country the subject has attracted but few workers, and they can almost be counted on the fingers of one hand. When we have mentioned the late Prof. H. A. Nicholson and Mr. Etheridge, jun., Mr. E. Wethered, Dr. Brown, Dr. Hinde, and Prof. Seward, we have practically exhausted the list of those who have contributed to our knowledge of the subject. To these we may add the name of Mrs. Robert Gray, whose magnificent collection of fossils from the Ordovician rocks of the Girvan district has always been freely placed at the disposal of geological workers, and has furnished numerous examples of these organisms to Prof. Nicholson and the officers of the Geological Survey.

It was Nicholson and Wethered who first recognised the important part played in the formation of limestones by certain organisms, which, though referred at the time to the animal kingdom, are now generally considered to represent the remains of calcareous algæ.

The presence of these organisms in a fossil state, especially in the older geological formations, has only been recognised in comparatively recent years; though it was suggested as long ago as 1844 by Forchhammer[2] that fucoids, by abstracting lime from sea-water, probably contributed to the formation of Palæozoic deposits. When we remember that it was

[1] Geikie. "Text-book of Geology." 4th ed., vol. i, pp. 605 and 611. 1903.

[2] British Association, 1844, p. 155.

not until the researches of Phillipi were published in 1837 that certain calcareous deposits were discovered to be directly due to the growth of living forms of lime-secreting algæ, it is not surprising that, only in comparatively recent years, has the importance of the fossil forms as rock-builders in past geological formations been recognised.

The original genera established by Phillipi—namely, Lithothamnion and Lithophyllum—are known now to have a wide distribution in the present seas, and it is therefore natural that it was members of these groups which were the first to be recognised in a fossil state in Tertiary and, subsequently, in upper cretaceous rocks.

Thus in 1858, Prof. Unger of Vienna showed the important part played by Lithothamnion in the constitution of the Leithakalk of the Vienna Basin, while seven years later Rosanoff contributed further to our knowledge of tertiary forms. In 1871 Gümbel published his monograph on the "so-called Nullipores found in limestone rocks," with special reference to the Lithothamnion deposits of the Danian or Maestricht beds. Since then Lithothamnion has also been reported from Jurassic rocks, and even from beds of Triassic age, though in the latter case, at all events, the reference to this genus appears to require confirmation. In this country the recognition of fossil calcareous algæ dates from a considerably later period. It will be best first to review the chief genera which appear to be referable to the calcareous algæ, and afterwards to show the part they play as rock-builders in the different geological formations.

Two important genera are usually recognised at the present day as occurring in the British Palæozoic and Mesozoic rocks—namely, Solenopora and Girvanella—and to these I propose to add Wethered's genus, Mitcheldeania, together with certain new forms from the Carboniferous rocks of the North of England, which appear also to be referable to this group.

Solenopora.

This genus was first created by Dybowski in 1877 for the reception of an obscure organism, from the Ordovician rocks of Esthonia, which he described under the name *Solenopora spongioides,* and regarded as referable to the Monticuliporoids.

Nicholson and Etheridge in 1885 (*Geol. Mag.*, p. 529) showed that the form described by Billings in 1861 as *Stromatopora compacta,* from the Black River limestones of North America, was in reality Dybowski's genus Solenopora, and in all probability was specifically identical with the form from Esthonia. Moreover, they considered that the organism they themselves had described under the name of *Tetradium Peachii* in 1877, from the Ordovician rocks of Girvan, was also referable to Billing's species, though perhaps a varietal form. Thus *Solenopora compacta* was shown to have a very wide distribution in Ordovician times.

Nicholson in 1888 defined the genus as including "Calcareous organisms which present themselves in masses of varying form and irregular shape, composed wholly of radiating capillary tubes arranged in concentric strata. The tubes are in direct contact, and no coenenchyma or interstitial tissue is present. The tubes are thin-walled, irregular in form, often with undulated or wrinkled walls, without mural pores, and furnished with more or fewer transverse partitions or tabulæ." [3]

At that time Nicholson still considered Solenopora as representing a curious extinct hydrozoon, though already, in 1885, Nicholson and Etheridge had discussed its possible relationship to the calcareous algæ. They did not, however, consider that there was sufficient evidence for concluding that the true structure of Solenopora was cellular, but added: "If evidence can be obtained proving decisively the existence of a cellular structure in Solenopora, then the reference of the genus to calcareous algæ would follow as a matter of course." [4]

In 1894 Dr. A. Brown investigated more fully the material which had been placed in his hands by Prof. Nicholson, and gave an account of all the forms referable to Solenopora known at that date.

To those already recorded, he added descriptions of four new species from the Ordovician rocks—namely, *S. lithothamnioides, S. fusiformis, S. nigra,* and *S. dendriformis,* the two latter being from the Ordovician rocks of Esthonia.

In the same paper also he published for the first time a description of a new species of Solenopora from the Jurassic rocks of Britain, to which Nicholson, in manuscript, had already assigned the name of *S. jurassica,* though, as will be pointed out later, it is probable that two distinct forms were included by Brown under this name.

This record of Solenopora from the lower Oolites of Britain extended the known range of this genus, for the first time, well into the Jurassic period. In this paper Brown first brought forward good evidence for removing Solenopora from the animal kingdom, and placing it among the coralline algæ, and Prof. Seward, in Vol. i. of his work on fossil plants, considers that there are good reasons for accepting this conclusion.

At the time of the publication of Dr. Brown's paper, and for some years afterwards, the only formations in which Solenopora was known to occur were the upper Ordovician and the lower Oolites. The diversity of forms, however, met with in the Ordovician rocks, and their widespread distribution, pointed to the probability of the existence of an ancestral form in the older rocks, while it also appeared incredible that no specimens of intervening forms should have been preserved in the rocks representing the great time-gap between the Ordovician and Jurassic formations.

In this connection Prof. Seward remarks [5]: "It is reasonable to prophesy that further researches into the structure of ancient limestones will considerably extend our knowledge of the geological and botanical history of the Corallinaceæ." This prophecy has been amply fulfilled, especially as regards this particular genus, and recent discoveries go far towards filling the previously existing gaps in our knowledge of the vertical distribution of this interesting genus.

Thus the recent detection in the lowest Cambrian rocks of the Antarctic continent of a form which appears to be referable to this genus enables us to trace the ancestry of Solenopora back almost to the earliest rocks in which fossils have yet been discovered, while the gap in the succession which previously existed between the Ordovician and Jurassic forms was decreased by the description in 1908 by Prof. Rothpletz of a new species *Solenopora Gothlandica,* from the Silurian rocks of the Faröe Islands in Gotland.[6] A large number of deposits, however, still remained, between the Gotlandian and lower Jurassic beds, from which no example of Solenopora had so far been recorded.

The identification, therefore, a few years ago, by Dr. G. J. Hinde, of examples of this genus from among the nodules I had collected from the Shap dolomites, is of considerable interest, as the presence of Solenopora in the lower Carboniferous rocks of this

3 "Geol. Mag., 1888, Dec. 3, vol. v, p. 19.

4 "Geol. Mag., 1885, Dec. 3, 2, p. 534.

5 *Op. cit.*, p. 190.

6 "Kungl. Svenska, Vets. akad. Handl." Bd. 42, No. 5, 1908, p. 14, pl. iv., pp. 1-5.

country materially decreases the gap in our knowledge of the succession of forms belonging to this genus, which had previously existed.

Girvanella.

This organism, which is now known to be widely distributed in the Palæozoic and Mesozoic rocks of this country, was originally described in 1878 by Nicholson and Etheridge, jun., from the Ordovician rocks of the Girvan district. The genus was established to include certain small nodular structures composed of a felted mass of interlacing tubes, having a width of 10 and 18 μ, the cells being typically simple, imperforate tubes without visible internal partitions. The geno-type, *G. problematica,* was, however, at that time referred to the Rhizopods and regarded as related to the arenaceous foraminifera ("Silurian fossils in the Girvan district," 1878, p. 23). In 1888 Nicholson, in redescribing this genus in the *Geological Magazine*, compares Girvanella with the recent form *Syringammira fragillissima* of Brady.

More recently Mr. Wethered has shown that an intimate association frequently exists between Girvanella tubes and oolitic structure, and he has described several new species of Girvanella, from the Palæozoic rocks and also from certain Jurassic limestones.

The reference of Girvanella to the calcareous algæ, though not yet supported by incontestable evidence, has been advocated by several writers in recent years. Even as long ago as 1887, Bornemann, in describing examples of Siphonema (Girvanella Nich.), which he had discovered in the Cambrian rocks of the Island of Sardinia, suggested that this organism might belong to the calcareous algæ.

In 1891 Rothpletz noticed that some of the specimens of Girvanella which he had examined were characterised by dichotomous branching of the tubes; on this account he removed the genus from the Rhizopods to the calcareous algæ, placing it provisionally among the Codiaceæ. Three years later Dr. A. Brown, in summing up the evidence in favour of the inclusion of Solenopora among the nullipores, expressed the opinion that Girvanella might ultimately come to be regarded as referable to the Siphoneæ Verticillatæ.

In 1898, however, this genus was still only doubtfully placed with the calcareous algæ, for Seward, in his work on fossil plants,[7] remarks: "The nature of Girvanella, and still more its exact position in the organic world, is quite uncertain. . . . We must be content for the present to leave its precise nature still *sub judice,* and, while regarding it as probably an alga, we may venture to consider it more fittingly discussed among the Schizophyta than elsewhere."

In 1908, however, Rothpletz, in discussing the relationship of Spherocodium and Girvanella, reaffirms his opinion that the latter must be referred to the Codiaceæ.[8]

Mitcheldeania.

This genus was first described by Mr. Edward Wethered from the lower Carboniferous beds of the Forest of Dean[9] under the name of *Mitcheldeania Nicholsoni*; it was referred by him to the Hydractinidæ, and considered to be allied to the Stromatoporoids. The figure accompanying this paper unfortunately fails to show any of the characters of the organism, but a better figure of the same species was subsequently published in the Proceedings of the Cotteswold Naturalists' Field Club.[10]

[7] Vol. i, p. 125.
[8] Rothpletz. "Ueber Algen und Hydrozoen," *op. cit.*
[9] "Geol. Mag.," Dec. 3, 3, ccccxxxv, 1886.
[10] Vol. ix. p. 77, pl. v., 1886.

In 1888 Prof. H. A. Nicholson published in the *Geological Magazine* figures and descriptions of a new species of this genus (*M. gregaria*), and redefined the genus as having "the form of small, rounded, or oval calcareous masses made up of capillary tubes of an oval or circular shape, which radiate from a central point or points, and are intermixed with an interstitial tissue of very much more minute branching tubuli." He compares the larger tubes to zooidal tubes, and states that they "communicate with one another by means of large, irregularly-placed foramina resembling 'the mural pores' of the Favisitidæ, and they occasionally exhibit a few irregular transverse partitions or tubulæ."

With regard to the systematic position of this genus, Nicholson remarks: "In spite of the extreme minuteness of its tissues, the genus Mitcheldeania may, I think, be referred with tolerable certainty to the Cœlenterata . . . its closest affinities seem to be with the hydrocorallines . . . on the other hand, all the known hydrocorallines possess zooidal tubes which are enormously larger than those of Mitcheldeania; and there are other morphological features in the latter genus which would preclude its being actually placed, with our present knowledge, in the group of the Hydrocorallinæ."

Since this description by Prof. Nicholson, no further account of this organism, so far as I am aware, has been published, and its reference to the Hydrozoa rests on Prof. Nicholson's description.

During the past few years I have collected a large amount of material from both of the type localities from which Mr. Wethered and Prof. Nicholson obtained their specimens, and an examination of this material has impressed me strongly with the resemblance of Mitcheldeania to forms such as Solenopora and Girvanella, now usually classed among the calcareous algæ. In the rocks in which it occurs Mitcheldeania appears as rounded and lobulate nodules, breaking with porcellanous fracture and showing concentric structure on weathered surfaces, very similar to nodules of Solenopora; while under the microscope the branching character of the tubules and their comparatively minute size appear to separate them from the Monticuliporoids. Prof. Nicholson appears to rely on the presence of pores, which he thought he observed in the walls of both the larger and finer tubes, for the inclusion of this genus with the hydrocorallines, though he appeared to be doubtful about their occurrence in the interstitial tubuli. An examination of a large number of slides has failed to convince me of the presence of pores, even in the larger "zooidal tubes." The large "oval or circular" apertures noticed by Nicholson appear to be either elbows in the undulating tubes cut across where these bend away from the plane of the section, or places where a branch is given off from a tube at an angle to the plane of the section. If this view be accepted, there appears to be no sufficient reason why Mitcheldeania should not be ranged with Solenopora and other similar forms, and included among the calcareous algæ—a position which its mode of occurrence and general structure has led me, for some time, to assign to this organism.

In addition to the three chief forms described above from British rocks, a study of numerous thin sections from the Lower Carboniferous rocks of the north-west of England has revealed the presence of several distinct organisms, which will, I think, eventually be found to be referable to the calcareous algæ.

This meagre list appears to exhaust the genera known at the present time from the Lower Carboniferous rocks of Britain, while the only additional genus so far recorded from the Mesozoic and Tertiary rocks of this country (if we except Rothpletz's subgenus Solenoporella) is Chara from the Wealden beds of Sussex, the uppermost Jurassic of the Isle of Wight and Swanage, and the Oligocene of the Isle of Wight.

Outside of this country the literature on fossil calcareous algæ is much more extensive. The interest originally aroused on the Continent by the writings of Phillipi, of Unger of Vienna, Cohn, Rosanoff, Gümbel, Saporta, and Munier-Chalmas has been further maintained in our own time by Bornemann, Steinmann, Früh, Solms-Laubach, Rothpletz, Walther, Kiaer, and others; while the more favourable conditions which obtained for the growth of these organisms, especially during Silurian, Triassic, and Tertiary times, has afforded a much wider field for their observation.

Thus, in addition to the forms recorded from this country, an important part has been played by members of the family of the Dasycladaceæ, together with such genera as Spherocodium, Lithothamnion, and Lithophyllum.

It is now time to turn to the consideration of the part played by these organisms in the formation of the sedimentary rocks through the successive geological periods.

ARCHÆAN.

In the Archæan rocks no undoubted remains of Algæ have, so far as I am aware, yet been recorded, but Sederholm considers that certain small nodules in the Archæan schists of Finland may represent vegetable remains. I may also perhaps here refer to some curious oolitic structures which I met with in Spitsbergen in 1896 when examining the rocks of Hornsund Bay. These oolites occur on the south side of the bay, and are closely connected with massive siliceous rocks which may represent old quartzites. The whole series is much altered, and detailed structure cannot now be made out. The rocks occur apparently stratigraphically below the massif of the Hornsund Tind, and may belong either to the Archæan or the base of the Heckla Hook series. As, however, similar rocks have not been recorded from the type district of Heckla Hook, they may be referred provisionally to the Algonkian, and may represent the quartzites and earthy limestone of the Jotnian series of Scandinavia. They are mentioned here in connection with Mr. Wethered's view that oolites are essentially associated with the growth of Girvanella.

CAMBRIAN.

Passing on to the Palæozoic rocks, we find in the Cambrian deposits very few indications that calcareous algæ played any considerable part in their formation.

This is no doubt due, in part, to the conditions under which these deposits accumulated in the classical localities where true calcareous deposits are typically absent. In the Durness limestone, however, where considerable masses of dolomites occur, the conditions would appear at first sight to have been more suitable for the growth of these organisms; but even here the slow rate of accumulation and the large amount of contemporaneous solution may have militated against their preservation. At the same time, it is possible that a systematic search in the calcareous facies of the Cambrian rocks in the north of Europe and America might result in the discovery of the remains of some members of this group. That there is ground for this suggestion is shown by the recent work in the Antarctic continent.

Prof. Edgworth David and Mr. Priestly have discovered among the rocks in the north-west side of the Beardmore Glacier dark grey and pinkish-grey limestone containing the remains of Archæocyathinæ, Trilobites, and sponge spicules, together with abundant remains of a small calcareous alga referred provisionally to Solenopora; from the photographs exhibited by Prof. David on the occasion of his address to the Geological Society I have little doubt that this reference is correct.

A further occurrence is also reported from fragments of a limestone breccia collected by the Southern party from the western lateral moraine of the same glacier. Speaking of the fauna discovered in this limestone, Prof. David remarks: "The whole assemblage is so closely analogous with that found in the Lower Cambrian of South Australia as to leave no doubt as to the geological age of the limestones from which these fragments are derived."[11] This discovery, therefore, extends the vertical range of this widely spread genus down to the oldest Palæozoic rocks. It is interesting to note that the rocks in which the Solenopora occurs contain a development of pisolite and oolite, and that this is also the case in the Australian equivalents. In 1887 and again in 1891 Bornemann described and figured species of Siphonema and Confervites[12] from the Archæocyathus limestones of Sardina. As regards the former genus, it was shown by Dr. Hinde[13] to be congeneric with Girvanella (Nich and Eth). It is of interest, however, to note that Bornemann describes this form as a calcareous alga, and compares it with existing sub-aerial algæ growing on the surface of limestone rocks in Switzerland. The latter is stated by Seward to be possibly "a Cambrian algæ, but the figures and descriptions do not afford by any means convincing evidence."

More recently, in 1904, Dr. T. Lorenz has described remains of Siphoneæ from the Cambrian rocks of Tschang-duang in Northern China, for which he erects two new genera, Ascosoma and Mitscherlichia, placing them in a new family, the Ascosomaceæ. These algæ build important beds of limestone, the individuals often attaining a length of 4 cm. and a thickness of 1½ cm. In 1907 Bailey reported Girvanella associated with oolites in the lowest Cambrian Man-t'o beds in China. It is probable, therefore, that as our knowledge of these rocks is extended calcareous algæ will be found to play an important part in the Cambrian limestones of the Asiatic continent and Australia.

ORDOVICIAN.

In the Ordovician rocks, the remains of calcareous algæ become much more abundant. They are very widely distributed, and for the first time they become important rock-builders. In Britain, the chief genera met with are Girvanella and Solenopora. These two organisms occur abundantly in the Scottish Ordovician rocks of the Girvan area, where they appear to have contributed largely to the limestones of the Barr series in Llandeilo-Caradoc times.

As already mentioned, the genotype of Girvanella—*G. problematica*—was originally described by the late Prof. Nicholson and Mr. Etheridge, jun., from the Craighead limestone, where it occurs in great numbers in the Craighead limestone at Tramitchell. The officers of the Geological Survey also report it from the Stinchar limestone of Benan Hill.

It occurs in the form of small rounded or irregular nodules, varying in diameter from less than a millimetre to more than a centimetre—many of the nodules showing marked concentric structure. During a recent visit to Girvan I was much struck by the important part played by this organism in the formation of these upper compact limestones In Benan Burn, where these beds are admirably exposed, the

[11] Eleventh Inter. Congress Report, 1910, p. 775.
[12] "Nova Acta. Coes. Leop. Car.," 1887 and 1891.
[13] Hinde, "Geol. Mag.," 1887 p. 226

Girvanella nodules occur conspicuously on the weathered surfaces, being so abundant as to constitute thick layers of limestone.

Solenopora compacta, var. *Peachii*, which, likewise, forms important masses of limestone, occurs, like *Girvanella problematica*, in the Girvan area, but at a somewhat lower horizon, namely, in the nodular limestone and shales forming the lower sub-division of the Stinchar limestone. It was originally described from pebbles in the Old Red Conglomerate of Habbie's Howe by Nicholson and Etheridge, jun., under the name *Tetradium Peachii*, and was subsequently discovered to occur plentifully in the Ordovician limestone at Tramitchell and Craighead, and to be synonymous with *Solenopora compacta* (Bill). In the shales associated with the nodular limestone of Craighead it occurs as spheroidal and botryoidal nodules up to 1½ in. in diameter; while in the limestone itself the nodules may have a diameter of 3 in. On freshly fractured surfaces it appears as buff-coloured on brownish spots, having a compact porcellanous texture, while weathered surfaces often show a concentric structure. Under the microscope the tubes of this species vary in diameter from 50–80 μ.

In the Geological Survey Memoir it is also recorded, under the original name of *Tetradium Peachii*, from the Stinchar limestone of Benan Burn, Millenderdale, and Bougang, where it is accompanied by two other species, *S. filiformis* and *S. fusiformis*,[14] which contributes conspicuously to the deposit, often forming large masses of limestone. The horizon of the Stinchar limestone is correlated by Prof. Lapworth with the Craighead limestone, and considered to represent the summit of the Llandeilo or the base of the Caradoc of the Shropshire district. It is of interest to note that Solenopora is here accompanied at times by well-marked oolitic structure, and that the same is true of the pebbles with which it is associated in the conglomerate at Habbie's Howe.

Although the marked development of Solenopora found in the Stinchar limestone ceases with the advent of the Benan conglomerate, the genus appears to have survived in the district into Upper Caradoc times, for Dr. Brown describes a new species (*S. lithothamnioides*) from Nicholson's collection from the Ordovician (? Silurian) at Shalloch Mill, where it occurs in conical masses the size of a walnut. The only beds in which we might expect algæ to occur in this locality are the nodular limestones or Dionide beds of the Whitehouse group of Prof. Lapworth's classification, but there is no mention of Tetradium or Solenopora from this locality in the fossil lists cited from Mrs. Gray's collection in the survey memoir.

As this point is of some interest, I have consulted Mrs. Gray, who very kindly sent me some small nodules which she had collected from the Whitehouse beds of Shalloch Mill. On slicing one of these I find that it is undoubtedly a Solenopora, and probably the species figured by Dr. Brown as *S. lithothamnioides*. A tangential section cut from this specimen shows clearly why the original specimen of Solenopora from Craighead was mistaken for Tetradium by Nicholson and Etheridge, jun.

South of the Scottish border there is, so far as I am aware, only one locality from which calcareous algæ have been recorded in rocks of Ordovician age, namely, Hoar Edge in Shropshire. Here large examples of *Solenopora compacta* were obtained in 1888 by Prof. Lapworth from the calcareous layers near the base of the Hoar Edge sandstone. The specimens were handed to Prof. Nicholson, who records the circumstance in his description of *S. compacta* in the *Geological Magazine* for 1888. The form

[14] Brown, *op. cit.*, pp. 195–197.

occurs here at the base of the Caradoc beds, and therefore at a horizon which corresponds closely to that of the Craighead limestone of Girvan.

Prof. Lapworth also informs me that he has obtained specimens of Solenopora from a limestone in south-west Radnorshire. As the upper portion of the limestone in which it is found contains a Silurian fauna, it is possible that it is here present at a higher horizon, though the constancy with which it occurs elsewhere, in beds of Llandilo-Caradoc age, would seem to point to the possible presence of beds of Upper Ordovician age in this area. In any case, its occurrence here is of considerable interest.

Foreign Ordovician.

Outside of Britain, one of the most interesting developments of calcareous algæ in rocks of Ordovician age occurs in the Baltic provinces.

As already stated, Solenopora was first recorded from Herrküll in Esthonia, by Dybowski under the name of *Solenopora spongioides*. It occurs here in the Upper Caradoc or Borckholm beds of Schmidt's classification—where it makes up thick beds of limestone—and it is noteworthy that this horizon is practically identical with that at which *S. lithothamnioides* (Brown) occurs at Shalloch Mill.

Other specimens of *Solenopora* were collected by Prof. Nicholson in Saak, south of Reval, from the underlying Jewe beds, an horizon which corresponds very closely to that of the Craighead limestone of Girvan. Speaking of these beds, Nicholson and Etheridge remark: "At this locality *S. compacta* not only occurs as detached specimens of all sizes, but it also makes up almost entire beds of limestone; indeed, some of the bands of limestone at Saak look like amygdaloidal lavas, while others have a cellular appearance from the dissolution out of them of the little pea-like skeletons of this fossil."

In Prof. Nicholson's collection from these beds Dr. Brown afterwards distinguished two new species, namely, *S. nigra* and *S. dendriformis*. Thus in the Ordovician rocks of Esthonia, Solenopora plays quite as important a part (as a rock-forming organism) as it does in the Girvan district in Ayrshire.

In Norway again, in the Mjösen district to the north of Christiania, Solenopora occurs plentifully in Stage 5 of Kiaer's Ordovician series. Here it is very abundant and often builds entire beds, while, further east, at Furnberg, Kiaer again records the occurrence of abundant nodules of *Solenopora compacta*, var. *Peachii*.

In addition to Solenopora, however, examples of another important group of calcareous algæ, the Siphonæ, occur in great abundance in the Ordovician rocks of the Baltic region, where they play a part in the formation of calcareous rocks, scarcely less important than that played by Gyroporella and Diplopora in the rocks of the Alpine Trias.

The chief forms belong to the family of the Dasycladaceæ, represented by the recent genus Neomeris, and include the genera Palæoporella, Dasyporella, Rhabdoporella, Verimporella, Cyclocrinus, and Apidium. These algal limestones represent the beds from the Jewe to the Borckholm beds inclusive. They were originally investigated by Dr. E. Stolley, who described their occurrence in the numerous boulders which are strewn over the North German plain in Schleswig-Holstein, Pommerania, Mecklenburg, and Mark-Brandenberg. Many of these boulders can be identified by their lithological character and fossil contents as belonging to the Jewe beds of the Baltic Ordovician formations. Others have been derived from the overlying Wesenberg limestones, while yet others occur which resemble the succeeding Lyckholm beds of the Baltic succession. This assemblage proves that the boulders did not originate on the Swedish continent, but from the more easterly-lying districts, probably from a part of the Baltic between Oeland and Estland, now covered by the sea. Similar boulders are also known at Lund in Schœnen, on Bornholm, and near Wisby in the north of Gotland.

These facts appear to show that during the deposition of the Jewe and the overlying Wesenberg and Lyckholm limestones an algal facies obtained which extended from Oeland to Estland and as far north as the Gulf of Bothnia.

But even this area does not represent the full extent of the algal limestone facies in Upper Ordovician times. In Norway, Kiaer has shown by his detailed work in the Upper Ordovician rocks, Stage 5 of the Christiania district, the important part played by the Dasycladacea in this area. Here the Gastropod limestone in places forms a "phytozoan limestone," made up of Rhabdoporella, Vermiporella, and Apidium associated with a considerable development of oolite.

Again at Kuven and Valle, in the Bergen district, Reusch and Kolderup have described knolls of crystalline limestone containing abundant remains of Rhabdoporella (formerly described as Syringophyllum) associated with a gastropod and coral fauna. This horizon they have unhesitatingly referred to zone 5*a* of Kiaer's sequence, and state that it may be found stretching from Geitero in the S.S.W. by Kuven, Valle, and Trengereid to Skarfen on Ostero, while Reusch has traced it further south to Stordo, near Dyviken and Vikenes.

We have, therefore, in Upper Ordovician times, in the north of Europe, one of the most remarkable developments of algal limestones met with throughout the geological succession. In North America also algæ are represented in Ordovician times by *Solenopora compacta*, which occurs in the Trenton and Black River limestones groups, whence it was originally obtained by Billings. It therefore occurs here at about the same horizon as in Saak and Britain.

We may also note the occurrence of Girvanella in the underlying Chazy limestone originally described by the late Prof. H. M. Seeley under the name *Strephochetus ocellatus*, but now generally admitted to be a form of Girvanella.

Other forms referred to this genus have also been reported by Schuchert from rocks of undoubted Ordovician age on the east coast of the Behring Straits.[15]

Silurian.

The rocks of Silurian age in Britain, in which calcareous algæ play an important part, appear to be limited to the Wenlock limestone, from which Mr. Wethered has described the constant occurrence of Girvanella tubes, especially in the beds of this age at May Hill, at Purley, near Malvern, and Ledbury.[16] Of these beds Mr. Wethered remarks: "The most interesting result of the microscopic study of these rocks was the discovery of new and interesting forms of Girvanella and the fact that this organism has taken so important a part in building up the limestone." It may here be mentioned that it was whilst studying these forms in the Wenlock limestone that Mr. Wethered first began to favour the suggestion of Rothpletz, published two years previously, in favour of Girvanella belonging to the calcareous algæ, for he remarks: "I certainly think that the forms which I have discovered in the Wenlock limestone seem more favourable to the vegetable theory of the origin of this fossil than those described in my former paper, and possibly it may be allied to the calcareous algæ."

So far as I can ascertain, this is all that has been published up to the present time with regard to the occurrence of calcareous algæ in British Silurian rocks; but I have every confidence that a more thorough microscopic examination of these rocks will reveal the presence of many other examples of this group.

Foreign Silurian.

Outside Britain at this period we find the most marked development of an algal facies, once more in the Baltic area, where, especially in the island of Gotland, algal growths contribute enormously to several of the limestones and marls. It is an interesting fact that very shortly after the disappearance of the various members of the Dasycladaceæ which were so much in evidence in Ordovician times, we have the marked development of another group of the Siphoneæ, which quickly reached a maximum, building up in their turn abundant calcareous deposits. Nodules from these limestones have long been known from Gotland under the name of "Girvanella Rock," and have been recorded by Stolley in boulders scattered over the North German plain. In 1908, however, Prof. Rothpletz showed, in his interesting work on these Gotland deposits,[17] that the forms hitherto alluded to under the term "Girvanella" were in reality referable to two different genera. One of these he showed to be a new species of Solenopora, to which he gave the name *S. gothlandica* (distinguished from *S. compacta* by the comparatively small dimension of the tubes, which are only about one quarter of the diameter of *S. compacta*, the genotype); the other he referred to his genus Spherocodium, which he had created in 1890 for certain forms from the Alpine Trias. The survival here of Solenopora into beds of undoubted Silurian age is an interesting fact and would lead us to expect that it may also some day be found in rocks of corresponding age in this country.

Of the different forms of algæ which occur in these Gotlandian deposits, perhaps the most interesting is Spherocodium. This organism occurs at several horizons in the succession. It first makes its appearance in the marl immediately overlying the Dayi flags—approximately of Lower Ludlow age—where Spherocodium occurs in considerable masses. Through the kindness of Dr. Munthe, who has made a special study of these beds in south Gotland, I have been able to examine specimens of this interesting form. In external appearance they resemble very closely nodules of Ortonella from the Lower Carboniferous of the north-west of England; some of the nodules appear to have reached a diameter of 1½ in. The bed is overlain by sandstone and oolite, which are succeeded by an argillaceous limestone rich in nodules of *Spherocodium gotlandicum* and well exposed at Grötlingbo, where it is closely associated with oolite. Among the fossils of this limestone Spherocodium itself plays a most important *rôle*.

In the overlying Iliona limestone, Spherocodium is decidedly rare, and its place is taken by nodules of Spongiostroma. It is, however, found not infrequently forming a thin crust on some of the nodules of Spongiostroma, which have also been described by Prof. Rothpletz (*op. cit.*). In appearance, Spongiostroma resembles very closely the nodules of Spherocodium, showing the same concentric arrangement round coral fragments and total absence of the radial structure which is so characteristic of Solenopora.

The actual systematic position of this organism, if organism it be, is still undecided. In his original

15 See Hang. 2, 1, 643.

16 Q.I.G.S., xlix, p. 236, 1893.

17 "Ueber Algen und Hydrozoen in Silur von Gotland und Oesel" Kungl. Sven. Vet. Handl. Band 43. No. 5, 1908.

description of this genus from the Carboniferous rocks of Belgium, Gürich refers it provisionally to the Protozoa, while Rothpletz in his description of the two species *S. balticum* and *S. Holmi* from the Gotlandian of Gotland, although admitting the difficulties of assigning it to any group of the animal kingdom, decides in favour of its hydrozoan affinities.

As will be pointed out later, there appears to be no good reason why Spongiostroma may not be indirectly the result of algal growths; but whatever may be the final position assigned to it, there can be no doubt as to its importance as a rock-building form in the Iliona limestone of Gotland. The wide extent of this algæ horizon in the Upper Silurian of the Baltic area is shown by the abundance of boulders of these rocks scattered over Schleswig-Holstein, and it is probable that a careful examination will show the presence of this facies in the Silurian to the east of the Baltic provinces.

We may conclude, therefore, that the development of the Spherocodium beds of Gotland probably occupy as wide an extension in the Baltic area as that of the Rhabdoporella limestones in the Ordovician period.

With regard to other occurrences in Silurian rocks, it will be sufficient to note that of Girvanella in the Silurian limestones of Queensland, Australia, recorded by Mr. G. W. Card in 1900, and more recently by Mr. Chapman from Victoria.[18]

Quite recently Mr. R. Etheridge, jun., of Sydney,[19] has described "an organism allied to Mitcheldeania from the Upper Silurian rocks of New South Wales"; the figures given, however, and the description are not convincing that his identification can be accepted. The size of the tubes, which are from five to six times that of the largest tubes of *M. gregaria*, alone would appear to separate this organism from Mr. Wethered's genus, and almost certainly from the calcareous algæ.

Devonian.

So far as I am aware, there is only one recorded occurrence of calcareous algæ in the Devonian rocks of Britain—namely, in the Hope's Nose limestone, from which Mr. Wethered has described aggregations of tubules resembling Girvanella, but in a very poor state of preservation. It is hoped that this meagre list will be increased in the near future.

Foreign Devonian.

On the Continent the records are, so far, equally poor. At the same time, the cursory examination which I was able to make of the thin sections of the Devonian limestones exhibited in the Brussels Museum leads me to expect that a careful investigation of the Belgian Devonian limestones will yield other examples besides Spongiostroma.

Carboniferous.

We now reach the period in Paleozoic times when calcareous algæ attained their maximum development in England, a development rivalling that which obtained in the Ordovician rocks of Scotland and the Gotlandian of Scandinavia. The genera here represented include Girvanella, Solenopora, and Mitcheldeania. In addition to these, there occur several lime-secreting organisms which, though still undescribed, will, I think, ultimately come to be included among the calcareous algæ. The most interesting of these organisms I have recently figured from the Lower Carboniferous rocks of Westmorland, where it forms a definite zonal horizon or "band."[20] For this form, on account of its stratigraphical importance and for facility of reference, I propose the generic name of Ortonella.[21]

Again, at the same horizon in the North-west Province I have frequently noticed concretionary deposits of limestone which occur as finely laminated masses often lying parallel to the general direction of the bedding planes, which, on microscopic examination, show no definite or regular structure, but have every appearance of being of organic origin. Many of these puzzling forms resemble very closely the somewhat obscure structures found in the Visean limestones of the Namur basin in Belgium, of which beautiful thin sections are displayed in the Natural History Museum at Brussels,[22], and which Gürich has described and figured under various names—namely, Spongiostroma, Malacostroma, &c., and included under a new family the Spongiostromidæ,[23] and a new order, the Spongiostromaceæ. He gives the following definition of the family: "Organismes marins, incrustants, coloniaux, à structure stratifiée. La structure de la colonie est indiquée, à l'état fossile, par la disposition de petits grains opaques (granulations), entre lesquels il y a des interstices, tantôt plus étroits, tantôt plus larges—canaux du tissu et canaux coloniaux—donnant naissance à un tissu spongieux. Dans plusieurs formes, on a observé des Stercomes," and suggests that they may possibly have been encrusting foraminifera.

I must confess that neither in the original sections nor in the beautiful illustrations which accompany his work can I see any grounds for referring these structures to the protozoa.

As regards the British specimens, I have long regarded them as due, directly or indirectly, to the work of calcareous algæ, on account of their intimate association with well-developed examples of these organisms, and, secondly, on account of the entire absence of foraminifera and other detrital organisms wherever this structure occurs. As, however, I have little doubt that they are closely connected in their mode of origin with the Belgian specimens, we may conveniently speak of them under the general term Spongiostroma.

Some of the best examples known to me occur associated with Ortonella in the "*Productus globosus* band" near the summit of the "*Athyris glabristria* zone" in the Shap district. They occur here in considerable masses, often many inches in thickness, and form undulating layers parallel to the bedding, and somewhat resembling huge ripple-marks. Thin sections show little definite structure, but consist of what appears to be an irregular flocculent precipitate of carbonate of lime, the interstices being filled with secondary calcite. Some of the layers resemble almost exactly, both in hand specimens and microscopic structure, the figures of *Malacostroma concentricum* given by Gürich in plates xvii. and xx. (23). Others approach closely to the same author's figures of Spongiostroma, Aphrostroma, &c. In all cases they appear to be due to the precipitation of carbonate of lime in the neighbourhood of algal growths. I have also met with similar deposits, not only at other horizons in the Lower Carboniferous of the north of England, but also in the Forest of Dean and in the rocks of the Avon Gorge; while quite recently Mr. C. H. Cunnington has sent me examples from several horizons in the Carboniferous limestones of South Wales.

Girvanella.

This organism appears to play a considerable part in the formation of calcareous deposits in the Lower Carboniferous rocks of Britain. Its presence in these

[18] Rep. Austr. Assn. Adv. Sci., 1907-8.
[19] Rec. Geol. Surv. N. S. Wales, vol. viii, pt. iv., 1909, p. 308, pl. 47.
[20] Q.J.G.S., 1912, vol. lxviii. pl. 67, fig. 2.

[21] From Orton, a village between Shap and Ravenstonedale, where this organism occurs in great abundance.
[22] One of these is also exhibited at the Jermyn Street Museum.
[23] "Mem. du Musée Roy. d'Hist. Nat. de Belgique," iii, 1906.

rocks was first suggested by the late Prof. Nicholson,[24] in his paper where he remarks: "I have found some of the Carboniferous limestone of the north of England to contain largely an ill-preserved organism which will, I think, prove to be referable to Girvanella." This prophecy has turned out to be fully justified not only as regards the north of England, but also in the case of other Lower Carboniferous districts. In 1890 Mr. E. Wethered described[25] two new forms from the Lower Carboniferous of the Avon Gorge and Tortworth, viz., *G. incrustans*, with tubes having a diameter of 0·1 mm., and *G. Ducii* with a diameter of 0·02 mm. Mr. Wethered appears to rely chiefly on the size of the tubes for the differentiation of these species, but as this distinction was made at the time when Girvanella was still considered to belong to the Rhizopods, and as the size of the tubes frequently varies in the same specimen, it is doubtful whether these species can be maintained. Mr. Wethered's specimens were obtained from the limestone near where the Bridge Valley road joins the river bank, apparently at the base of Dr. Vaughan's Upper Dibunophyllum zone. The position of this limestone is of interest, as it appears to correspond very closely with the horizon of the Girvanella nodular bed, which forms a well-marked band at the base of the Upper Dibunophyllum zone throughout the whole of the north and north-west of England. Indeed, I have traced this band at intervals from the neighbourhood of Ford, near the Scottish border, southwards through Northumberland and the Pennine area to Penygent, and from the west coast at Humphrey Head through Arnside and Shap to the east coast, near Dunstanburgh. These organisms must, therefore, have flourished over an area of at least 3000 square miles.

The Girvanella tubes found associated with these nodules usually occur in two distinct sizes having diameters of 0·03 and 0·01 mm. respectively. The two forms are closely associated, but the finer tubes occur in greater abundance, and are much more closely interlaced. They resemble Mr. Wethered's description of the two species from Gloucestershire, and the figures he gives in illustration of these might serve very well to represent our northern forms.

The best exposure showing the important development of these Girvanella nodules is to be found on the dip slopes forming the eastern shore of Humphrey Head in Morecambe Bay, where the base of the Upper Dibunophyllum zone is exposed over a considerable area.

Solenopora.

The discovery of a specimen of this genus in the Lower Carboniferous rocks of Westmorland is of considerable interest, as its occurrence here gives us some insight into the history of its wanderings between the time when we last recorded it in the Gothlandian rocks of the Baltic area, and its reappearance in the Lower Oolite of Gloucestershire. Whether it lived in the Baltic area during the Devonian and Carboniferous periods is, however, still unknown. The fact of its occurrence in the Caradoc, Carboniferous, and Jurassic rocks of the British Isles would appear to point to its existence not far off during the intervening periods, and I have hopes that before long it may be found in the Silurian, and possibly also in the Devonian rocks of this country.

In Westmorland and Lancashire Solenopora occurs in considerable abundance near the local base of the Lower Carboniferous rocks, and contributes largely to the formation of limestone deposits. It is present wherever the lowest beds of the succession are exposed, as at Shap, Ravenstonedale, and Meathop, and must formerly have flourished over a considerable area.

Though bearing a general resemblance, both in hand specimens and microscopic structure to the Ordovician and Jurassic forms, it has recently been shown by Dr. G. J. Hinde to be specifically distinct.[26] It occurs as small, spheroidal nodules up to an inch in diameter, having a markedly lobulate outline embedded in compact and usually dolomitic limestones, and it is occasionally associated with oolitic structure. When fractured, it exhibits the compact porcellanous texture and pale brownish tint characteristic of specimens of the genus found at other horizons; while weathered surfaces frequently show a concentric and occasionally a radially fibrous structure. It is noteworthy that the thallus of this organism shows no trace of dolomitisation, even when embedded in limestone containing over 30 per cent. of $MgCO_3$. The profusion of this form in Westmorland would lead one to expect its occurrence in other districts where the lowest Carboniferous zones are developed; but so far as I am aware, no such occurrence has yet been recorded. It may be of interest, therefore, to mention here that a few years ago my friend, Mr. P. de G. Benson, brought me a specimen of rock from near the base of the succession in the Avon Gorge, which on cutting I found to contain several examples of Solenopora identical with the Westmorland form. It is probable, therefore, that a careful microscopic examination of the lower horizons of the Carboniferous rocks of the south-west province will lead to the discovery of other examples of this interesting genus.

Mitcheldeania.

The specimens of *Mitcheldeania Nicholsoni* originally described by Mr. Wethered were obtained from Wadley's Quarry, near Drybrook, Mitcheldean, from the lower limestone shales at the base of the succession. Prof. Sibly, who has recently made a careful study of the Lower Carboniferous succession in the Forest of Dean,[27] has traced this algal layer over a considerable area, and considers it to represent a horizon near the top of K.I. of the Bristol sequence. He has also noted examples of Mitcheldeania at a higher level, namely, in the Whitehead limestone, an horizon corresponding probably to the base of C2. During a recent visit to the Mitcheldean district I collected specimens from both the lower shales, and also from the Whitehead limestone, and, thanks to Prof. Sibly's kind directions, I was able to see numerous sections in which he has found this algal development. There can be no doubt that Mitcheldeania is here an important rock-forming organism at least at two horizons in this district, and that it occurs over a considerable area. In the case of the upper horizon it frequently contributes largely to the rock, forming in places almost entire layers in the Whitehead limestone. As regards the forms met with at these two horizons, the upper form found in the Whitehead limestone agrees exactly in general characters and mode of occurrence and also in detailed microscopic structure, with Nicholson's species, *M. gregaria*, from Kershope Foot. The character of the two sets of tubes, their size and mode of arrangement is identical, and it is impossible to distinguish between sections of well-preserved specimens from the two localities. Unfortunately, the specimens from the lower shales at Mitcheldean are very badly preserved, but if Nicholson's distinction between the two species holds, we shall have to speak of the form

24 *Op. cit.* p. 24.
25 *Q. J. G. S.*, vol. 47, p. 280, pl. 11, figs. 1 and 2. 1890.

26 *Geol. Mag.*, Dec. 5, x, 289. 1913.
27 *Geol. Mag.*, Dec. 5, 417.

from the lower horizon at Mitcheldean as *M. Nicholsoni,* and that from the Whitehead limestones as *M. gregaria.* Frequently associated with the latter is a curious *festoon-like* growth, while a Spongiostroma-like structure is often found in the matrix of the rock between the larger tubes of *M. Nicholsoni.* Some years ago Mr. Wethered also recorded a similar form of Mitcheldeania from the base of the middle limestones of the Avon Gorge, while I have myself collected nodules containing specimens apparently referable to *M. Nicholsoni* from the Modiola Shales near the base of the succession. Interesting as the development of Mitcheldeania in the Forest of Dean undoubtedly is, its real home in Britain is in north Cumberland and the Scottish border, where it flourished to a remarkable extent in the shallow water lagoons which spread over so large an area in the north of England during early Carboniferous times. Over the greater part of north Cumberland and the east of Roxburgh we find a remarkable development of algal limestones in the formation of which Mitcheldeania plays a very important part. They are met with especially at two horizons, an upper one, lying immediately below the Fell Sandstone, and a lower one in the middle of the underlying series of limestone and shales. The lower horizon is especially interesting on account of the thick masses of limestone composed almost entirely of algal remains. Though Mitcheldeania forms the basis of this reef-like development, it is accompanied by other algal forms, especially bundes of minute tubules of Girvanella and coarser tubes reminding one of the Spherocodium of Gotland. In places again the marked concentric coatings resemble certain forms of Spongiostroma. The substance of the reef has frequently formed round the remains of Orthoceratites; indeed, the chief layer is usually associated with remains of these Cephalopoda. With other layers occur tubes of Serpulæ, and others again with ostracod remains. In addition to the limestone of this massive reef, abundant nodules lie scattered through the calcareous shales above and below.

The upper layer, which includes examples from Nicholson's type locality, forms a compact limestone several inches thick. It is made up of small spheroidal nodules about half an inch in diameter, and occurs a short distance below the Fell Sandstone. It can be traced over the whole of north Cumberland and north-west Northumberland from near Rothbury on the east to the Scottish border at Kershope Foot, and from the head waters of the Rede in the north, to the Shopford district in the south. This layer must therefore have been originally deposited over an area of at least 1000 square miles. The horizon of the upper band is almost certainly that of the C. zone of the Bristol sequence.[28] It is quite possible, therefore, that it is contemporaneous with the Whitehead limestone of Mitcheldean. This supposition receives support from two other pieces of evidence. In the beds underlying the *Mitcheldeania gregaria* band in north Cumberland occur calcareous nodules largely made up of tubes of Serpulæ—an organism which is completely absent from the Westmorland succession, but which is reported by Prof. Sibly from the lower limestone shales containing Mitcheldeania in the Forest of Dean district. Again, this upper algal layer in Northumberland and Cumberland is almost immediately overlain by the Fell Sandstone series, while the Whitehead limestone at Mitcheldean passes immediately upwards into a sandstone, the Drybrook Sandstone of Prof. Sibly, which was originally correlated with the Millstone Grit, but was shown by Dr. Vaughan in 1905 to belong to the Lower Carboniferous series. It would be interesting if further researches should prove the existence of a former gulf at the end of Tournaisian times, running to the east of the North Wales Island, from the Forest of Dean through north Cumberland to the southern slopes of the Cheviot Isle, with a branch given off towards eastward into Westmorland.

In any case, it is a remarkable fact that we have a great development of algal deposits at this period in Gloucestershire, Westmorland, Lancashire, north Cumberland, and Northumberland.

Ortonella

This form, as already mentioned, occurs in great abundance in the algal band in the "*Athyris glabristria* zone" of the north-west province It is found in spherical nodules up to the size of a small orange. In microscopic sections it resembles Mitcheldeania in so far as it consists of a series of tubes growing out radially from a centre. It differs, however, from this genus in many important respects. All the tubes are approximately of the same size, and there is no evidence of alternating coarse and fine turfs arranged concentrically, as in the case of Mitcheldeania. Further, the tubes are not undulating as in that genus, and therefore in thin slices lie for a long distance in the plane of the section. They are much more widely spaced and show marked dichotomous branching, bifurcation making a nearly constant angle of about 40°, and there is a strong tendency for the branching to take place in several tubes at about the same distance from the centre of growth, producing a general concentric effect in the nodule.

The diameter of the tubes is decidedly less than those in Mitcheldeania, being usually little more than half the size of the tubes of *M. gregaria* The nodules of this genus occur in great profusion, contributing largely to the formation of the shaley dolomite at the base of the "*P. globosus* band" throughout the Shap, Ravenstondale, and Arnside districts and Westmorland and Lancashire.

In addition to these genera there occur also two other encrusting calcareous growths which require mention. The first of these appears in thin sections in the form of a *festoon-like growth,* surrounding fragments of calcareous algæ, especially Mitcheldeania and Ortonella. I have met with it abundantly in the "Algal band" in the north-west of England, but it also occurs not infrequently associated with Mitcheldeania in the Whitehead limestone in the Forest of Dean, while a similar structure occurs associated with *Mitcheldeania gregaria* in north Cumberland.

Although the exact nature of this growth is still undecided, I mention it here on account of its invariable association with undoubted calcareous algæ.

The other deposit is the form already alluded to under the term Spherocodium which I have found forming considerable masses of rock in many districts where the Lower Carboniferous beds are exposed; not only in Westmorland and north Cumberland, but also in the Bristol district, the Forest of Dean, and South Wales.

Foreign Carboniferous.

From its general similarity to the British deposits we might expect to find examples of an algal development in some portion of the Belgian Lower Carboniferous succession. As already mentioned, large masses of encrusting calcareous deposits have been described by Gürich[29] from the Visean limestones of the Namur basin as Spongiostroma, &c., which, though referred by him to the Rhizopoda, may very

[28] "Geology in the Field," pt. 4, p. 683, and *Q. G. S.*, vol. 73, 1912, p 547.

[29] "Les Spongiostromides du Viséen de la Province de Namur. Mem. du Musée Roy. d'Hist. Nat. de Belgique," t. iii 1906.

well be calcareous precipitates deposited by algal influence. Many of these deposits are similar to those mentioned above from British rocks.

No undoubted remains of calcareous algæ have, however, yet been recorded from these Belgian rocks. It may be of interest, therefore, to mention the recent discovery by Prof. Kaisin, of Louvain, of undoubted algal remains in the beds overlying the Psammites-de-Condroz at Feluy, on the Samme. The form found here resembles Ortonella of the Westmorland rocks, but the tubes are much finer, and it may turn out to represent a species of Micheldeania. During a recent visit to Belgium I had the pleasure of visiting the Comblain au Pont beds, in the Feluy section, with Prof. Kaisin, and, although these beds have been previously classed as Devonian, I agree with him that they probably belong to the base of the Carboniferous, and correspond approximately to K of the Bristol sequence. In the company of Prof. Dorlodot and Dr. Salée, I also visited the chief sections of the Visean, and we succeeded in discovering at least three horizons at which nodular concretionary structures, probably referable to algal growths, occurred. It is pretty certain, therefore, that careful microscopic investigation of the Belgian rocks will show the presence of calcareous algæ at more than one horizon.

One other occurrence of Girvanella may be mentioned from foreign Carboniferous rocks: that is a form described by Mr. H. Yabe from the (?) Carboniferous rocks of San-yu-tung and other localities in China under the name of *G. sinensis*.[30]

Permian and Trias.

In Britain I have met with no reference to the occurrence of calcareous algæ in rocks of this period, but quite recently Mr. Cunnington, of H.M. Geological Survey, sent me a few nodules from the base of the Permian which resemble very closely fragments of Spongiostroma from the Carboniferous limestone, and may be derived from that formation.

Abroad, masses of limestone, composed almost entirely of remains of Diplopora and Gyroporella, have long been known from the Muschelkalk and lower Keuper beds of the eastern Alps, notably the Mendola Dolomite, the Wetten limestone of Bavaria, and the Tyrolian Alps—from the Zugspitz to Berchtesgaden. In the Hauptdolomit and from the Fassa Dolomite of the north limestone Alps and the stratified Schlern dolomite of the southern Tyrol. In the Lombard Alps the same facies reappears, and *Diplopora annulata* occurs abundantly in the well-known Esino limestone above Varenna.

In 1891 Rothpletz[31] showed that certain spherical bodies in the Triassic beds of St. Cassian, formerly regarded as oolitic structures, were in reality algal growths, and referred them to a new genus, Sphœrocodium, on account of their apparent resemblance to the living form Codium. He describes them as encrusting organisms forming nodules up to several centimetres in diameter. They contribute substantially to the rocks in which they occur, and are found especially in the Raiblkalk, the Kossenerkalk, and the Plattenkalk.

Jurassic.

The Mesozoic rocks of Britain contain but few examples of marine algal limestones, and important occurrence are confined to the Jurassic Rocks. The forms met with are limited to two genera, Girvanella and Solenopora.

Tubes of Girvanella occur fairly abundantly in the British Oolites, especially in the well-known Leckhampton Pisolites, and Mr. Wethered, who has made a special study of oolitic structures, appears inclined to refer all oolitic structures to organic agency of this nature.

The examples of Solenopora met with in the Great Oolite and Coral Rag are of special interest. In both cases they attain very much larger dimensions than any species yet discovered in the Palæozoic rocks.

At Chedworth, near Cirencester, I have collected masses of *Solenopora jurassica*, measuring up to a foot across, in which the original pink tint is still so conspicuous on freshly fractured surfaces as to give rise to the local appellation of "Beetroot Stone," and the colour also reminds one of the red algæ growing in great profusion at the present day in the Gulf of Naples.

It is also recorded from the same horizon by Dr. Brown from Malton in Yorkshire, and also, on the authority of the late Mr. Fox Strangways, by Prof. Rothpletz. (*Op. cit.*)

In Yorkshire, however, a form undoubtedly occurs at a higher horizon, namely, in the Coral Rag of the Scarborough district, where it is well known to local collectors. Specimens which I have collected from this horizon at Yedmandale and Seamer also attain a considerable size—up to six inches in their longest dimension.

The name *S. jurassica* was given by Prof. Nicholson in manuscript to the specimens from Chedworth, and was adopted by Dr. Brown in his description of specimens from both Chedworth and Malton.

Prof. Rothpletz points out that specimens examined by him from Yorkshire differ from the genotype in the fact that the cells are typically rounded in cross section and by the absence of perforations in the cell-walls, and he therefore proposes to separate it as a new genus Solenoporella. It seems probable that some confusion has arisen between the specimens to which Nicholson originally gave the name of *S. jurassica* from the Great Oolite of Chedworth and other specimens from a higher horizon—the Coral Rag—examined by Dr. Brown and Prof. Rothpletz.

The former indeed figures a longitudinal section from Chedworth (Glos.) and a tangential section from Malton (Yorkshire).

I have collected specimens from both horizons and consider that whilst the Chedworth specimen, to which the name *Solenopora jurassica* was originally given, represents a species of true Solenopora, showing closely packed cells with polygonal outline in tangential section, the form from the Coral Rag of Yorkshire, with distinct circular outline to the tubes in tangential section is specifically, if not generically, distinct, and is that described by Rothpletz as Solenoporella.

If this view be correct we should continue to speak of the specimens from the Great Oolite at Chedworth as *Solenopora jurassica*, while those from the Coral Rag of Yorkshire must be known as Solenoporella *sp.* Rothpletz.

Foreign Jurassic.

It is surprising that records of the occurrence of calcareous algæ in foreign Jurassic rocks are at present very scarce.

Quite recently, however, Mr. H. Yabe[32] has described a new species of Solenopora, under the title *Metasolenopora Rothpletzi*, from the Torinosu limestone Japan. This discovery is of interest, as it carries the known occurrence of Solenopora up to the base of the Cretaceous, in which formation Lithothamnion appears and thenceforward becomes the

[30] H. Yabe, "Science Reports of the Tâhoku Imp. Univ.," Japan, 1912.
[31] "Zeitsch. d. deut Geol. Ges.," 1891.

[32] *Op. cit.*, p. 2

chief representative of the rock-building coralline algæ.

CRETACEOUS.

We here reach the period when Lithothamnion and its allies begin to make their appearance. They have not yet been recognised in British rocks, but are widely distributed in Continental deposits. They occur in the Cenomanian of France, in the Sarthe and the Var, but especially in the Danian of Petersburg, near Maestricht.

Other forms which may be mentioned are Diplopora and Triploporella. The former is met with abundantly in the lower Schrattenkalk in certain districts, especially Wildkirchli, where it plays a considerable part in the formation of the deposit.[33]

TERTIARY.

In Britain no important deposits of marine calcareous algæ have yet been reported, but considerable deposits of limestone, rich in remains of Chara, have for long been known from the Oligocene of the Isle of Wight.

Foreign Tertiary.

On the Continent, however, large deposits rich in Lithothamnion and Lithophyllum have been known for many years, among which I may mention the well-known Leithakalk of the Vienna Basin and Moravia. It will be remembered that it was these deposits which formed the subject of Unger's important monograph in 1858.

CONCLUSIONS.

The facts given above regarding the geological distribution and mode of occurrence of these organisms lead us to several interesting conclusions. In addition to the evidence of the important part they play as rock-builders, it is evident that certain forms flourished over wide areas at the same geological periods, and might well be made use of in many cases with considerable reliability as proofs of the general contemporaneity of two deposits. Thus, as general examples, we may cite the wide distribution of *Solenopora compacta* in the Baltic provinces, Scotland, England, Wales, and Canada during Llandilo-Caradoc times.

The wonderfully persistent development of the *Rhabdoporella* facies over the whole of the Baltic area at the close of Ordovician times was of so marked a character that by means of boulders scattered over the north German plain it can even be made use of for tracing the direction of flow of the ice-sheet during glacial times.

Again, to take examples nearer home. The Ortonella band found throughout Westmorland and north Lancashire near the summit of the Tournaisian occurs so constantly at the same horizon as to constitute one of the most valuable zonal indices in the succession of the north-west province, and can be used with the greatest confidence not only for correlating widely separated exposures, but also affords valuable evidence in the case of tectonic movements. Other examples are supplied by the "Girvanella nodular band" at the base of the Upper Dibunophyllum zone, and the *Mitcheldeania gregaria* beds in the north of England and the Forest of Dean.

Again, the presence of these organisms at a particular horizon furnish us with interesting evidence as to the conditions which obtained during the accumulation of these deposits.

At the present day calcareous algæ flourish best in clear but shallow water in bays and sheltered lagoons. As a good example we may take the algal banks in the Bay of Naples, described by Prof. Walther,[34] where Lithothamnion and Lithophyllum flourish to a depth of from 50–70 metres. There is seldom any muddy sediment on these banks, though detrital limestone fragments are widely distributed. Another interesting point is the constant association of fossil calcareous algæ with oolitic structure and also with dolomite.

Thus oolites occur in connection with Solenopora in the lower Cambrian of the Antarctic, in the Craighead limestone at Tramitchell in the Ordovician rocks of Christiania and the Silurian of Gotland and in the Lower Carboniferous limestone of Shap; while in the Jurassic rocks of Gloucestershire and Yorkshire it occurs in the heart of the most typical oolitic development to be met with in the whole geological succession. Though Mr. Wethered has made out a good case for the constant association of Girvanella tubes with oolitic grains, there are many cases in which their association cannot be traced. M. Cayeux,[35] in writing of a mass of Girvanella from the ferruginous oolites of the Silurian rocks of La Ferrière-aux-Etangs, expresses his opinion that Girvanella encrusts the oolite grains but does not form them, and that it is really a perforating alga of a parasitic nature.

The presence of dolomites in connection with algal deposits at different geological horizons appears to have taken place under definite physiographical conditions similar to those which obtain to-day in the neighbourhood of coral reef. Such lagoon conditions would come into existence *either* during a period of subsidence *or* elevation, and this is just what we find when we examine the periods at which these reefs are most persistent.

Thus the Girvan Ordovician reef occurred during an elevation which culminated with the deposition of the Benan Conglomerate; the Lower Carboniferous Algal band in Westmorland was laid down during the subsidence which followed the Old Red Sandstone Continental period of the Upper Girvanella; modular band occurred when the Marine period of the Lower Carboniferous was drawing to a close and a general elevation was taking place. Similar conclusions could be drawn from other periods recorded above did time permit.

In concluding this address, I wish to express the hope that however imperfect the account I have given of the succession of forms may be, that it will help to stimulate an interest in these rock-building algæ and encourage geological workers in this country to turn their attention to a hitherto neglected group of forms of great stratigraphical importance.

33 Lorenz, 1908.

34 "Zeitsch. d. deut. Geol. Ges." 1885, p. 230, and "Abh. d. Königl. Preuss. Akad. der Wiss," 1910.

35 *Comptes Rendus Acad. de Sci.*, 1910, p. 359.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—Dr. Charles Crowther, formerly lecturer in agricultural chemistry, has been appointed professor in that subject, and will have charge of the experiments in animal nutrition, which are being supported by a grant from the Development Commissioners.

The Council of the University has granted six months' leave of absence to Prof. Smithells, who is leaving England on September 26 to proceed to Lahore, where he is to give a course of lectures and to assist the Punjab University in other ways in the promotion of scientific education and research.

The position of research chemist to the Joint Committee on Ventilation Research of the Institution of Gas Engineers and of the University of Leeds has been filled by the appointment of Mr. W. Harrison, of the Manchester Municipal School of Technology.

The medical school of the University of Leeds will hold its opening function on October 1, when Prof. C. S. Sherrington, F.R.S., will distribute the prizes and deliver an address.

LONDON.—Prof. E. W. MacBride, F.R.S., has been appointed successor to the late Prof. Adam Sedgwick in the chair of zoology at the Imperial College of Science, South Kensington.

THE presidency of Denison University has been accepted by Prof. C. W. Chamberlain, who, in consequence, has resigned the chair of physics at Vassar College.

THE new session of the Charing Cross Hospital Medical College will be opened on October 1 by an address from the dean, Dr. W. Hunter, on University medical education.

THE first Hunterian Society's lecture will be delivered at St. Bartholomew's Hospital on October 8 by Dr. F. J. Wethered, who will take as his subject "Fever in Pulmonary Tuberculosis: its Significance and Therapeutical Indications."

A CHAIR of hydrology and hygiene has been established at the Superior School of Pharmacy in Paris, which will take the place of one of mineralogy and hydrology. Prof. Délépine, the holder of the last-named chair, will occupy the new one.

DR. J. E. WODSEDALEK, of the zoological department of the University of Wisconsin, has been appointed professor of zoology and head of the department of zoology and entomology at the University of Idaho, Moscow, Idaho, in succession to Dr. J. M. Aldrich.

AN apprenticeship course in animal husbandry has been established at the Ohio State University. The course covers four years—two in the university and two in practical work on a stock farm. Many stock men in the United States are interested in the movement, and are cooperating with the University in carrying it out.

WE learn from *Science* that a bionomic laboratory has been established in connection with the University of Chicago, and that Prof. W. L. Tower, who has been appointed its curator, has left for South America to obtain material for it. The laboratory is to be equipped for the study of genetics and the problems of experimental evolution.

A SCHEME has been completed for the amalgamation of Bolton Grammar School and the High School for Girls in the town, and Sir William Lever has now endowed them as from January next with 50,000*l.* Lever Brothers 20 per cent. cumulative preferred ordinary shares, producing an income of 10,000*l.* per annum. The funds are placed at the discretion of the trustees, and it is proposed to use the first five years' income to build a new school with an administrative block.

A SCIENTIFIC and technical school of kinematography is to be inaugurated at the Polytechnic, Regent Street, W., on Wednesday, October 1. The opening meeting (which will be free) is to be followed by a course of twenty-four weekly lectures by Mr. R. Bruce Foster, who will deal with the subject under the following heads:—Historical development; modern film machines and intermittence mechanisms; films, their production and treatment; exhibiting; colour kinematography; the kinematograph combined with musical accompaniment; the Kinematograph Act and Regulations.

THE following lectures, among others, have been arranged for delivery at University College, London:—"Early Cylinders and Scarabs," Prof. Flinders Petrie, F.R.S.; "Primitive Religion in Egypt," Miss Margaret A. Murray; "The Scope of General Physiology," Prof. Bayliss, F.R.S.; "The Range of Consciousness in Organic Nature," Mr. Carveth Read; "Mental Energy," Prof. Spearman; "The Palæobotanist, his Past and Future," Dr. Marie Stopes. Particulars, syllabuses, &c., may be obtained from the Provost or the Secretary of the College.

AT University College, University of London, a course of lectures on the physical applications of the principle of relativity will be delivered on Fridays, at 5 p.m., by Dr. L. Silberstein, lecturer in natural philosophy at the University of Rome, beginning October 10. The syllabus includes consideration of the fundamental concepts and postulates of the theory of relativity, dynamics of radiation, fundamental electromagnetic equations, optical problems, the problem of gravitation, and Einstein's recent generalisation of the theory of relativity. Another course of lectures on the principle of relativity is to be given at Battersea Polytechnic by Mr. E. Cunningham, fellow of Trinity College, Cambridge, on Thursdays, at 6 p.m., beginning on October 23. The lectures will deal with the development of the principle and some consequences of the universal admission of the principle. Admission to this course is free and no ticket is required.

THE next session of Birkbeck College, which is the ninety-first, commences on September 29. The opening address will be given at 7 p.m. by Sir Francis Darwin, F.R.S., and visitors are invited to be present. The college is conducted in relation with the University of London, and classes are held both in the day and evening. We notice that thirty-two members of the staff are recognised teachers of the University of London. The courses of study provide for degrees in the faculties of arts, science, laws, and economics. It is again pointed out in the calendar, which contains full particulars of the numerous courses of study, that the usefulness of the college is curtailed by its limited accommodation. Its most pressing need is for increased space. More spacious college buildings, with additional class-rooms and larger laboratories better adapted to modern requirements, would give a great stimulus to the work of the college and add to its public utility.

THE report of the United States Commissioner of Education for the year ending June 30, 1912, has reached us from Washington. It consists of two large volumes, one dealing with educational topics in a broad way and the other devoted almost entirely to statistics. The section of the report concerned with the work of universities and colleges in the United States shows that the total amount of gifts to these institutions for higher education for the year 1911–12 was 4,956,600*l.*, excluding grants by Federal, State, and local political bodies. This amount represents an increase of 363,989*l.* over the benefactions for 1910–11. Of these gifts 1,274,960*l.* was for the increase of plant in the institutions, 745,980*l.* for current expenses, and 2,935,660*l.* for endowment. These amounts do not include subscriptions or promises received in campaigns for endowment, though they do include some property not producing an income at the present time. Fifty-four institutions reported gifts during the year of more than 20,000*l.* Five universities received more than 200,000*l.*, namely, Yale, Chicago, Harvard, Columbia, and Cornell. Columbia University seems to have been most fortunate with its 378,256*l.*

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 1.—Général Bassot in the chair.—H. **Deslandres** and L. **d'Azambuja**: Variations of the upper layer of the solar atmosphere with the approach of a sunspot minimum. An account of work done at the Observatory of Meudon from 1911 to 1913; a general account of the relations observed between spots and filaments; no general conclusions are drawn.—G. **Bigourdan**: The variable nebulæ and, in particular, the nebula G.C. 4473 = N.G.C. 6760. The observations of Borrelly on the change of luminosity of this nebula require confirmation.—A. **Laveran** and G. **Franchini**: Experimental infection of mice by *Herpetomonas ctenocephali*. The mice were infected with parasites obtained from fleas, and details are given of the changes undergone by the organism after transmission to the mouse.—Pierre **Duhem**: On the velocity of sound. A discussion of the formulæ given by Ariès and J. Moutier.—Charles **Saint-John**: Exploration of the solar atmosphere by measurements of the radial velocities in the spots. Evershed, in 1909, announced the displacement of the Fraunhofer lines in the penumbra of spots removed from the centre. The author commenced the more complete study of this phenomenon at Mount Wilson in 1910, and in the present communication summarises his results. The phenomenon is a Doppler-Fizeau effect, since the displacements are proportional to the wave-lengths. The relative levels of emission of the different lines can be determined by this method.—M. **de Séguier**: Quadratic and Hermitian groups in a Galois field.—Georges **Claude**: Influence of the diameter on the potential difference in luminescent neon tubes. The relation between the fall of potential in volts per metre of tube and the diameter of the tube was found to be hyperbolic.—Paul **Godin**: Influence of the weight of the arms on the respiratory modifications in the course of growth.—F. **Heckenroth** and M. **Blanchard**: A fixation reaction, in presence of a syphilitic antigen, in syphilis, yaws, trypanosomiasis, and phagedenic ulcer in the French Congo.

September 8.—M. **de Forcrand**: Experiments on the cupric hydrates and the heat of formation of copper nitrate. Comparison with uranyl nitrate. Calorimetric determinations on $Cu(OH)_2$, CuO, and intermediate hydrates.—J. **Guillaume**: Observations of the Metcalf comet (1913*b*) made at the Observatory of Lyons. Positions given for September 3, 5, and 6. On the 3rd the comet was of the tenth magnitude.—A. **Schaumasse**: Observations of the Metcalf comet (1913*b*) made with the Coude equatorial at the Observatory of Nice. Positions given for September 3, 4, 5, and 6. On the 3rd the comet appeared as a round nebulosity of about the tenth magnitude, about 2′ in diameter, with a badly defined nucleus.—M. **Moulin**: The terminal curves of balance springs. Influence of terms of the second order.—E. **Briner** and A. **Kuhne**: The mechanism of the formation of sulphuric acid in leaden chambers. The authors have been able to prove that pure dry nitrogen peroxide and sulphur dioxide react at 60° C., sulphur trioxide being formed. From the results of this experiment they discuss the possibility of the direct oxidation of sulphur dioxide to sulphuric acid in the leaden chamber.—J. A. **Urbain**: Morphological modifications and floral anomalies resulting from the suppression of the albumen in some plants. A study of the modifications in growth produced by removing the albumen from the seeds of various plants. Edm. **Bocquier** and Marcel **Baudouin**: The discovery and exploration of a prehistoric submarine station at the mouth of the Vie, in Vendée.—Paul **Jodot** and Paul **Lemoine**: The existence of a fault on the right bank of the Loire near Cosne.

September 15.—Général Bassot in the chair.—E. L. **Bouvier**: New observations on the larval development of the spiny lobster (*Palinurus vulgaris*). (See NATURE, August 21, p. 633.)—Jules **Andrade**: The regulation of a marine chronometer with four spirals.—Georges **Claude**: The drying of air to be liquefied by cooling. The difficulty of removing water by cooling in the ordinary heat exchanger is discussed. This can be surmounted by making the expanded gas circulate through the tubes of the exchanger instead of round them, whilst the compressed air circulates round the tubes, the path of the compressed air being composed of horizontal elements. The liquid water can be removed from the bottom without difficulty, and it is only at the end of fifteen to twenty-four hours that stoppages are produced by the hoar frost; a second exchanger is then substituted. The cost is very small compared with chemical methods of drying, and the apparatus has already been used in apparatus for the production of pure nitrogen on the large scale.—MM. **Taffanel** and **Le Floch**: The combination of gaseous mixtures and temperatures of inflammation. The combustible mixture is introduced suddenly into a vessel, the walls of which are at a known temperature, the combustion being recorded by a self-recording manometer. Results are given for mixtures of air with methane, hydrogen, carbon monoxide, acetylene, ethylene, pentane, and finely divided oil.—Maurice **Durandard**: The amylase of *Rhizopus nigricans*.

CAPE TOWN.

Royal Society of South Africa, August 20.—Dr. J. K. E. Halm in the chair.—E. J. **Goddard**: The significance of the position of the genital apertures in Hirudinea. The number of somites entering into the constitution of the Leech body is, according to one school, thirty-three, according to another thirty-four. This constitution holds good except in the doubtful exceptions of *Acanthobdella peledina* (Grube) and Semilageneta (Goddard). The ancestral stock from which the Hirudinea arose must have been Oligochætan and aquatic in nature, and having a body of 33 or 34 somites. This ancestor must have been provided with setæ, as indicated by Acanthobdella, similar to those found in aquatic Oligochæta such as Lumbriculidæ, Phreodrilidæ, &c. Further investigation may reveal a close association between the distribution of certain archaic Oligochætan families and the origin of the Hirudinea.—E. J. **Goddard**: A Phreodrilid from Sneeuw Kop, Wellington, South Africa. A new form has been discovered on the Wellington mountains. The ventral setæ are typically Phreodrilid in nature, but both are simple. Hence in Africa, which is apparently rich in Phreodrilids, all the varieties of setæ noted in the family are to be found in the African representatives.—G. C. **Scully** and A. R. E. **Walker**: Note on Spodumene from Namaqualand. The lithia-bearing mineral described in this paper was collected by the authors near Jackals Water, Steinkopf. An examination of its optical and other physical characters enables them, with confidence, to refer it to the species Spodumene. Quantitative chemical analyses of the mineral will be made, the results of which the authors hope to publish in a later paper along with a detailed account of the associated minerals.

BOOKS RECEIVED.

Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie. Edited by A. Engler. Band 50. Heft 2 and 3. (Leipzig and Berlin: W. Engelmann). 14 marks.

Zeitschrift fur Wissenschaftliche Zoologie. Edited by Prof. E. Ehlers. Band 106. Heft 3. (Leipzig and Berlin: W. Engelmann.) 11 marks.

Problem Papers. Supplementary to Algebra for Secondary Schools. By Dr. C. Davison. Pp. 32. (Cambridge: University Press.) 8*d.*

Canada. Department of Mines. Mines Branch. The Nickel Industry, with Special Reference to the Sunbury Region, Ontario. By Dr. A. P. Coleman. Pp. viii+206+plates. (Ottawa: Government Printing Bureau.)

Biology. By Dr. W. D. Henderson. Pp. 92. (The People's Books series.) (London and Edinburgh: T. C. and E. C. Jack.) 6*d.* net.

Sir Williams Huggins and Spectroscopic Astronomy. By E. W. Maunder. Pp. 94. (The People's Books series.) (London and Edinburgh: T. C. and E. C. Jack.) 6*d.* net.

Spiritualism and Psychical Research. By J. A. Hill. Pp. 94. (The People's Books series.) (London and Edinburgh: T. C. and E. C. Jack.) 6*d.* net.

Entstehung der Welt und der Erde nach Sage und Wissenschaft. By Prof. D. M. B. Weinstein. Zweite Auflage. Pp. vi+116. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Die Dampfmaschine. By Prof. R. Vater. II., Ihre Gestaltung und Verwendung. Pp. vi+99. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Memoirs of the Geological Survey. England and Wales. Explanation of Sheet 339. The Geology of the Country around Newton Abbot. By W. A. E. Ussher. Pp. vi+148+iii plates. (London: H. M. Stationery Office; E. Stanford, Ltd.) 3*s.*

Viśvakarmā: Examples of Indian Architecture, Sculpture, Painting, Handicraft. Chosen by Dr. A. K. Coomaraswamy. Part v. 12 plates. (London: Luzac and Co., Ltd.) 2*s.* 6*d.*

Die Kultur der Gegenwart ihre Entwicklung und ihre ziele. Edited by Prof. P. Hinneberg. Teil iii. and Teil iv. Pp. 84. (Leipzig and Berlin: B. G. Teubner.)

Drapers' Company Research Memoirs. Biometric Series ix. A Monograph on Albinism in Man. By Karl Pearson, E. Nettleship, and C. H. Usher. Part iv. Text. Appendices. Pp. iv+136+xxiii. Part iv. Atlas. Pp. iv+lix plates. (London: Dulau and Co., Ltd.) Text and Atlas, 21*s.* net.

Department of Marine and Fisheries. Report of the Meteorological Service of Canada, Central Office, Toronto, for the year ended December 31, 1909. Pp. xxi+565+4 plates. (Ottawa.)

Handworterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 54 and Lief. 55. (Jena: G. Fischer.) 2.50 marks each part.

Probleme der Entwicklung des Geistes. Die Geistesformen. By S. Meyer. Pp. v+429. (Leipzig: J. A. Barth.) 13 marks.

Quantitative Analysis in Practice. By Dr. J. Waddell. Pp. vii+162. (London: J. and A. Churchill.) 4*s.* 6*d.* net.

Practical Chemistry. By the late Prof. J. C. Brown. Sixth edition edited by Dr. G. D. Bengough. Pp. 78. (London: J. and A. Churchill.) 2*s.* 6*d.* net.

Report of the Commissioner of Education for the Year ended June 30, 1912. Vol. i. Pp. xxvi+647. Vol. ii. Pp. xviii+669. (Washington: Government Printing Office.)

Fire Tests with Glass. Three Window Openings filled in with "Luxfer" Electro-glazing by the British Luxfer Prism Syndicate, Ltd., London. The Committee's Report. Pp. 16. ("Red Books" of the British Fire Prevention Committee, No. 182.) (London: British Fire Prevention Committee.) 2*s.* 6*d.*

Practical Mathematics. By N. W. M'Lachlan. Pp. viii+184. (London: Longmans, Green and Co.) 2*s.* 6*d.* net.

A Medley of Weather Lore. Collected by M. E. S. Wright. Pp. 144. (Bournemouth: H. G. Commin.) 2*s.* 6*d.* net.

The Modern Geometry of the Triangle. By W. Gallatly. Second edition. Pp. vii+126. (London: F. Hodgson.) 2*s.* 6*d.* net.

Medizinische Physik. By Prof. Dr. O. Fischer. Pp. xx+1120. (Leipzig: S. Hirzel.) 36 marks.

The Upper Thames Country and the Severn-Avon Plain. By N. E. MacNunn. Pp. 124. (The Oxford Geographies.) (Oxford: Clarendon Press.) 1*s.* 8*d.*

DIARY OF SOCIETIES.

WEDNESDAY, OCTOBER 1.

ENTOMOLOGICAL SOCIETY, at 8.—The Urticating Properties of *Porthesia similis*, Fuess.: H. Eltringham.

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" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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A course of 10 Lectures and Demonstrations on the nature and properties of Colloidal substances, of the methods employed in their investigation, and of the bearing of Colloidal phenomena on Chemical and allied Industries.

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The first lecture of the Course will be held on Tuesday, October 7, at 7 p.m.

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For details of the Classes apply at the Office of the Institute, or by letter to the PRINCIPAL.

COUNTY OF LONDON.

The London County Council invites applications for the position of full time LABORATORY ASSISTANT (Woman) for the Botanical and Chemical Laboratories at the County Secondary School, Putney. Candidates should be between the ages of 18 and 21 years, and the commencing salary will be 18*s.* to 25*s.* a week according to age, rising to 30*s.* a week. The person appointed will be required to take up her duties in January, 1914. Candidates should apply by letter to the Education Officer, London County Council Education Offices, Victoria Embankment, W.C., by Wednesday, October 15, 1913, and should give full particulars of their age, qualifications, and experience.

Every communication must be marked H.4 on the envelope. Canvassing, either directly or indirectly, will be held to be a disqualification for appointment. No candidate who is a relative of a member of the Advisory Sub-Committee of the school is eligible for appointment.

JAMES BIRD,
Deputy Clerk of the London County Council.

Education Offices,
Victoria Embankment, W.C.,
September 24, 1913.

UNIVERSITY OF ST. ANDREWS.

CHAIR OF CHEMISTRY IN UNIVERSITY COLLEGE, DUNDEE.

THE UNIVERSITY COURT OF THE UNIVERSITY OF ST. ANDREWS invite applications for the CHAIR OF CHEMISTRY in University College, Dundee, fallen vacant by the death of Professor. Hugh Marshall, D.Sc., F.R.S.

Letters of application, which must be accompanied by thirty printed or type-written copies of the letter of application and relative testimonials must be in the hands of the undersigned on or before Friday, November 7.

Further particulars regarding the Chair may be obtained from the undersigned.

ANDREW BENNETT,
Secretary and Registrar.

The University, St. Andrews,
September 30, 1913.

UNIVERSITY OF ABERDEEN

AND

NORTH OF SCOTLAND COLLEGE OF AGRICULTURE.

It is proposed to appoint a BIO-CHEMIST for the RESEARCH DEPARTMENT in ANIMAL NUTRITION. The salary will depend on the qualifications and experience of the person appointed. Applications from thoroughly trained and experienced investigators are invited to be sent to the SECRETARIES, Joint Committee on Agricultural Research, Marischal College, Aberdeen, from whom further information can be obtained.

THURSDAY, OCTOBER 2, 1913.

THEORY AND PRACTICE OF CHEMISTRY.

(1) *Service Chemistry: Being a Short Manual of Chemistry and Metallurgy, and their Application in the Naval and Military Services.* By Prof. V. B. Lewes and J. S. S. Brame. Fourth edition, revised. Pp. xvi+576+vii plates. (London: Edward Arnold, 1913.) Price 15*s.* net.

(2) *Handbuch der Arbeitsmethoden in der anorganischen Chemie.* By Dr. A. Stahler. Erster Band. Pp. xii+786. (Leipzig: Veit and Co., 1913.) Price 25 marks.

(3) *Cours de Chimie Organique.* By Prof. F. Swarts. 2e édition revue et augmentée. Pp. vii+751. (Paris: A. Hermann et Fils; Gand: Ad. Hoste, 1913.) Price 15 francs.

(4) *Allen's Commercial Organic Analysis.* A Treatise on the Properties, Modes of Assaying, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicine, &c. Volume vii. Fourth edition. Edited by W. A. Davis and S. S. Sadtler. Pp. ix+563. (London: J. and A. Churchill, 1913.) Price 21*s.* net.

(1) TEACHERS of chemistry in colleges of applied science, who nowadays are so frequently requested to arrange specialised courses in this science suitable to the needs of students working chiefly at other subjects, will undoubtedly be interested to learn how this problem has been solved by the authors of this manual, now in its fourth edition, after long experience in the teaching of chemical science to naval officers. The writers very rightly refuse to compile a Service technology without first inculcating a knowledge of the facts and laws governing the results obtained in applied chemistry. At the same time, they carefully select their illustrations so as to arrest immediately the attention of the naval and military student, for whom the work is primarily intended.

Within the first dozen pages the topic of liquefied gases leads to a consideration of the production of "artificial ice and cold storage both on land and sea." The chemistry of galvanic batteries includes a description of Leclanché's cells used in firing torpedoes and submarine mines. The subject of combustion brings in a reference to the spontaneous ignition of coal on shipboard. Special prominence is given to explosives. The evolution of gunpowder is traced, and a concise account is given of the taming of guncotton for use as a propellant. Special sections are devoted to fuel problems, military ballooning, boiler incrustations, corrosion, protective paints, anti-fouling compositions, and many other matters arising out of Service vicissitudes.

From the doctrinal point of view, it would obviate much confusion if the term "atomicity" were employed exclusively to denote the number of atoms in an elementary molecule, and not used as a synonym for "valency." In this connection it may be mentioned that sulphur vapour at 500° C. is stated incorrectly to be hexatomic (p. 322). It is doubtful whether the affinity of the halogens for oxygen decreases regularly from iodine to fluorine. The non-existence of perbromic acid and bromine oxides rather suggests that bromine in this respect falls between chlorine and fluorine (pp. 333, 345). These points, which are open to criticism, are, however, of minor importance, and the work contains so much new material not generally found in chemical text-books that the authors are justified in hoping that the book may appeal to readers outside the circle of Service students.

(2) This work, which is the first of five volumes of a comprehensive text-book on working methods in inorganic chemistry, is a noteworthy example of the "integrated knowledge" now placed at the disposal of chemists called upon to plan the erection and organisation of laboratories for the practice of this important branch of chemical science. The information is characterised throughout by a note of thoroughness, first-hand knowledge being ensured by the author's collaboration with a staff of experts in different branches of practical chemistry. In their efforts to make every item of equipment purposive, the writers take nothing for granted, and discuss in detail such matters as the ample provision of light and space round the laboratory building, the ready accessibility of stairways and exits, the storage in cellars of volatile liquids and liquefied gases, and even the position of bicycle stands! Certain illustrations of various shapes of retort stands and specimen bottles might well be left to the dealers' catalogues.

The varieties of glass suitable for chemical purpose are fully discussed, and it may be noted that the rare alkali metal rubidium has been utilised in the production of a hard glass softening only at 1000° C. Shenstone's pioneering efforts in the production of silica ware are mentioned, and further developments are suggested by references to the use of zirconia and titania in the fabrication of crucibles and refractory apparatus. Considerable improvements have been recently made in the manufacture of porcelain, and vessels

F

of this material are now obtainable which withstand rapid fluctuations of temperature. The section on the noble metals refers not only to vessels of gold and platinum, but also to apparatus constructed of rhodium, iridium, and tantalum. The chemical and physical properties of the newer alloys (duralumin, the ternary steels, &c.) are reviewed. Scattered through the work are many valuable recipes likely to interest the practical chemist, as, for example, the use of aniline-black as a stain for woodwork, various lutings and cements for joining together chemical apparatus, and a composition for filling holes in platinum crucibles.

Special chapters are devoted to electrical fittings and to the mechanical operations of pulverisation, agitation, filtration, &c. The book affords a striking testimony of the pre-eminence of Germany in the newer industries which minister to the wants of applied chemistry. Some noteworthy products of British enterprise have, however, been overlooked, and mention may be made in this connection of Fletcher's earthenware combustion furnaces and Pilkington's glass screens with an embedded meshwork of invar steel, which form such efficient shields in working with explosive materials.

(3) In this text-book of organic chemistry the author has given prominence to the development of the theory of the subject, descriptive matter being restricted to a few substances of industrial importance. A chapter on chemical kinetics has been added because the fundamental principles of this branch of the science have been chiefly verified in connection with organic substances. From the outset stereochemical considerations are introduced, and the facts of isomerism, multiple linking, and ring formation are regarded from the point of view of the tetrahedral carbon atom. The constitution ascribed to double cyanides (pp. 174, 177) must, however, be regarded as obsolete, in view of Werner's recent researches on coordination compounds. The author omits all references to original memoirs, and the work can scarcely be recommended as a substitute for the larger English treatises on organic chemistry.

(4) This work is the seventh volume of the fourth edition of Allen's well-known treatise on organic analysis. The book is divided into seven sections, each of which is written by an expert on the subject, the entire compilation not only serving as a useful guide to the analyst, but forming also a comprehensive treatise on the general chemistry of the organic materials under review. The present volume is largely devoted to nitrogenous compounds either formed by the vital activities of plants and animals or arising from the decay of these organisms. In recent years considerable addition has been made to our knowledge of these products, among which may be mentioned the alkaloids of ergot, cyanogenetic glucosides, ptomaines, amino-acids, and purine derivatives. One section is devoted to lactic acid, and another to the bitter principles of aloes and hops, whilst the concluding chapter is a useful monograph on cyanogen and its derivatives. G. T. M.

SOME NEW ELECTRICAL BOOKS.

(1) *Electrical Photometry and Illumination: A Treatise on Light and its Distribution, Photometric Apparatus, and Illuminating Engineering.* By Prof. H. Bohle. Pp. xi + 222. (London: C. Griffin and Co., Ltd., 1912.) Price 10*s.* 6*d.* net.

(2) *The Principles of Applied Electrochemistry.* By Dr. A. J. Allmand. Pp. xii + 547. (London: Edward Arnold, 1912.) Price 18*s.* net.

(3) *Electroplating: A Treatise on the Electro-Deposition of Metals, with a chapter on Metal-Colouring and Bronzing.* By W. R. Barclay and C. H. Hainsworth. Pp. viii + 399. (London: Edward Arnold, 1912.) Price 7*s.* 6*d.* net.

(4) *The Design of Alternating Current Machinery.* By J. R. Barr and R. D. Archibald. Pp. xvi + 496 + xvi plates. (London: Whittaker and Co., 1913.) Price 12*s.* 6*d* net.

(5) *A Laboratory Manual of Alternating Currents.* By Prof. J. H. Morecroft. Pp. viii + 247. (London: Longmans, Green and Co., 1912.) Price 7*s.* 6*d.* net.

(6) *La Télégraphie et la Téléphonie Simultanées et la Téléphonie Multiple.* By K. Berger. Traduit par P. Le Normand. Pp. 134. (Paris: Gauthier-Villars, 1913.) Price 4.50 francs.

(7) *The Baudôt Printing Telegraph System.* By H. W. Pendry. Pp. iii + 147 + plates. (London: Whittaker and Co., 1913.) Price 2*s.* 6*d.* net.

(1) DURING comparatively recent years there has sprung into existence a new branch of science which is known, or knows itself, as illuminating engineering. The writer has a suspicion that if the electrical engineer who handled lighting problems had not been on the lookout for another stick with which to beat his brother gas engineer, and had not thought that stick was to be found in the greater ease with which scientific measurements can be applied to electric lamps, no such science would ever have sprung into a definite and separate existence. Be that as it may, the profession appears to be establishing itself with some degree of firmness. The illuminating engineer of theory is a man of unbiassed mind as regards the particular illuminant he employs, provided he attains his desired end in the most economical

manner: a man who instals electricity in your dining-room, gas in your kitchen, acetylene in your billiard room, and candles in your bedroom. But the illuminating engineer of practice is generally either a gas or electrical engineer with his own particular axe to grind. So much is this the case that he may show a marked preference (against all sound illuminating engineering doctrine) for a particular species of illuminant in the genus which he represents—as, for example, for flame arc lamps against all other electrical illuminants.

We do not know whether Prof. H. Bohle calls himself an illuminating engineer, but at least he has written a book (1) which claims in its subtitle to be a treatise on illuminating engineering, almost as if this were a mere appanage of electrical photometry and illumination; and, as one of the latest works on the new science, we turn to it naturally in the hope that it will more than justify that science's existence. It is disappointing to find little, if anything, more than used in our student days to be regarded as legitimately within the sphere of electrical engineering. It is disappointing, too, to find much inadequate treatment and, we are afraid, insufficient knowledge. Take, for example, the discussion of radiation laws in chapter ii. This is far from clear, and the statement on p. 21: "Coloured bodies absorb different parts of the impinged radiation: consequently they will radiate different fractions of black body radiations, according to the frequency, *i.e.* according to the temperature," is, if we understand the author's meaning rightly, not correct.

The description of the manufacture of carbon filament lamps in the same chapter must have been obtained from some out-of-date account. The criticism of the flame arc lamp on p. 97 is equally behind the times. It is stated that "on long winter evenings the lamps do not hold out until the next morning, but must be recarboned during the night." This is untrue of any flame lamps except those specially designed for short-hour lighting, and there are many flame lamps now on the market, and have been for years, which burn without recarboning for 70–100 hours, so that it will be seen that the criticisms of the author, who writes from Cape Town, would only be justified at the poles. Flame lamps burning vertical carbons are actually commended for steadiness as against lamps with inclined carbons, the exact reverse being the case. We were not surprised after this to find on p. 171 that the yellow flame arc is described as "suitable for decorative illumination," as apparently its only sphere of usefulness.

We need not, however, labour criticism of details such as these: it is only to be regretted that in discussing such a progressive subject as the manufacture and behaviour of electric lamps the author did not take more pains to bring his information up to date.

It is of interest to turn to what may be regarded as the more distinctly "illuminating engineering" sections of the book. We are told in the preface that this is a combined science of physics and physiology, and emphasis is laid on the neglect of the physiological side, which led us to expect that this would be remedied by the author. The physiological discussion in the book is, however, no more than is usually to be found in similar works. In truth, this plea for physiological investigation is, in our opinion, frequently exaggerated. The knowledge of a few elementary facts is necessary, but beyond this physiological knowledge is not needed, and it would be equally true to say that it was required as part of the equipment of a good tailor.

The last two chapters, "The Design of Reflectors and Shades" and "Illuminating Engineering," show how little the new science really has accomplished. With a few exceptions, which existed before the illuminating engineer had arrived, electric lamp shades are still, scientifically, as chaotic as ever. The design of shades is, in fact, for the most part, an art and should continue to be so: if the illuminating engineer ever succeeds in making it purely a science, he will remove what is one of the recommendations of electric lighting—that it lends itself to beauty as well as to utility. The chapter on illuminating engineering gives a number of directions for different classes of lighting which the unbiassed would admit are no more than a restatement of the common-sense practice of years—almost centuries.

We cannot omit reference to a novel procedure in the numbering of figures and equations. Thus the fifth figure in the fourth chapter is numbered Fig. 4.05: this is intended to facilitate reference. It has quite the contrary effect and we trust will not be imitated.

(2) Dr. Allmand's treatise is one of the most comprehensive and at the same time one of the best treatises on applied electrochemistry that we can call to mind in the English language. The first part, covering fourteen chapters and 194 pages, deals with the theoretical side of the subject. To write a complete exposition of the theoretical side of electrochemistry, it would almost be necessary to write a complete chemical treatise coupled with a much shorter discussion of the fundamental electrical phenomena. It is

essential, therefore, to assume a certain amount of chemical knowledge in the reader, and we are inclined to think, on the whole, that Dr. Allmand has not assumed too much.

It must be remembered however, that the student who approaches this subject from the electrical side is often seriously lacking in chemical grounding and, complete though Dr. Allmand's treatment is, we could not help feeling at times that the chemical reasoning and illustrations would be above the heads of many readers. This argument must not be given undue weight, as it is open to all who care to study the subject thoroughly to supplement the volume by the reading of other chemical and physico-chemical works, a matter which is greatly facilitated by the copious references to current literature and the bibliographical references at the end of each chapter. By the time the student has thoroughly mastered the theoretical discussion in the first part of the book he will be in a position to understand properly the reactions and phenomena involved in the various practical applications to which the second part is devoted.

The "special and technical" part of the work opens with two chapters on primary and secondary cells respectively. The treatment here is necessarily brief—whole volumes have been written dealing with each of these subjects—but it is clear and covers the more important points. An interesting discussion of the "fuel cell," a cell in which coal, or some simple derivative from coal such as carbon, or CO, is used to generate electrical energy, concludes the chapter on primary cells. There follow chapters on the electro-metallurgy of the principal metals, and on electrolytic bleaching, etc., and in chapters xxiv. to xxvi. the more important electro-thermic processes are discussed. The last two chapters deal with the oxidation of atmospheric nitrogen and the production of ozone.

Although, owing to natural conditions, this country is not to the fore in electrochemical and electrothermal development, the field for English engineers is not confined to England. There is good reason to hope, moreover, that the future, and very possibly the near future, will see much greater advances in this direction in England than one would have anticipated a few years ago. It is becoming more evident every year that not only is water power not an indispensable adjunct to electrochemical enterprises, but that other sources of power may possess decided advantages. The appearance of so thoroughly sound a treatise as Dr. Allmand's is therefore very much to be welcomed.

(3) Messrs. Barclay and Hainsworth have set out to write a thoroughly up-to-date handbook for the practical electroplater, and have succeeded admirably in realising their aim. Rightly insisting that even the most practical of practical men cannot in these days work without a more or less thorough groundwork in the theoretical side of his subject, they have devoted the first six chapters of their book to a succinct but thoroughly sound exposition of the fundamental chemical and electrical principles. These are treated in a manner well suited to the scope of the book, the elementary knowledge assumed being such as can hardly fail to be possessed by anyone seriously attempting to study the volume.

After two chapters dealing with plant and apparatus and preliminary processes such as cleaning, etc., the remaining chapters deal with the deposition of the various metals. Each of the more important metals is considered separately, and in each case the theoretical explanation of the various reactions involved is not forgotten. The composition of the various depositing baths having been considered from this viewpoint, the methods of making them up and the details of the actual electroplating process are dealt with. The book covers the deposition of all the metals of importance industrially and also of many the deposition of which has a very limited application. We can thoroughly recommend the book either to the practical electroplater or to the student anxious to familiarise himself with the details of a process of great commercial importance and great historical interest.

(4) Messrs. Barr and Archibald's volume on alternating current machinery is an advanced treatise suitable for the use of senior students and those actually engaged in the design of such machinery. The whole field is well covered: after preliminary chapters on complex wave forms and insulation, the subject of transformer design is dealt with in three chapters. These are followed by eight chapters on alternators and three on rotary converters.

(5) Mr. Morecroft's book is a collection of laboratory experiments designed to elucidate the more important current phenomena. We are glad to see that a method too frequently followed by the writers of such laboratory notes, that of confining the text to the merest statement of instructions, has been avoided and a clear exposition of the significance of the experiment has been given in each case. Although this may render the book less convenient for actual use in the test-room, it gives it much higher educational value.

(6) and (7) These two books deal with specific developments in the field of telegraphy and telephony, and may be regarded more as mono-

graphs for the specialist than as treatises for the general student. The detailed investigation of the more intricate telegraph systems is, in fact, probably outside the range of the general electrical engineer's ambitions. M. Berger's book is the more comprehensive of the two, not only because it deals with a somewhat wider subject, but also on account of the broader method of treatment which has been adopted. The subject is handled more theoretically, and there is very little purely descriptive writing. M. Pendry, on the other hand, deals mainly in description, and the book lacks something from the absence of the theoretical side. The descriptive writing is, however, clear, and numerous illustrations help to the better understanding of a very complex subject.

Maurice Solomon.

THE TEACHING OF PSYCHOLOGY.

(1) *The Learning Process.* By Prof. S. S. Colvin. Pp. xxv+336. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5s. 6d. net.

(2) *Introduction to Psychology.* By Prof. R. M. Yerkes. Pp. xii+427. (London: G. Bell and Sons; New York: H. Holt and Co., 1911.) Price 6s. 6d. net.

(3) *Experiments in Educational Psychology.* By Dr. D. Starch. Pp. vii+183. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 4s. net.

(1) PROF. COLVIN'S book is written from the point of view of "thorough-going functionalism and pragmatism." "All learning," we are told, "both expresses itself through adjustment and is acquired through adjustment." Now it is possible to give too narrow a meaning to the term adjustment. The solving of a problem, however theoretical, is adjustment in the important sense. That movement, on the other hand, is not the one thing needful has been made evident once for all by Mr. Squeers' pedagogic system:—"W-i-n-d-o-w, window, go and clean it." In short, the essential thing is that every piece of school work should be capable of being felt as a stage in the working out of a problem.

Prof. Colvin, it is true, does not definitely commit himself to too narrow a use of the term; indeed, in places he clearly guards himself against it. Yet one cannot but feel that these passages come rather as qualifications than as explanations of other earlier ones.

One problem which lends itself particularly well to treatment from this functional point of view is that of the expression and suppression of deep-seated emotional and conative tendencies. An interesting account is given of some of Freud's main positions, and sympathy is shown with the view that the attempt simply to suppress fundamental instincts is apt to be disastrous rather than merely futile. The problem of sex education is recognised, and the possibility faced that childhood may not be so completely asexual as has been supposed. That the existence of any problem has been so completely ignored is certainly strange, but, as things are, is perhaps hardly an unmixed evil. The child has in this domain at least been spared the interference of the many well-intentioned, the parents, parsons, and pedagogues, who would otherwise surely have rushed in, fearing to tread as little as any bull in a china-shop.

Many other topics are interestingly and instructively discussed—the economy and technique of learning; the main results of recent work on testimony; the problem of the transfer of training; the comparison of child and adult as to memory and reason; "hard" versus "soft" pedagogy, and so on.

The book is clearly written, and gives, without ostentation, a large amount of information based upon modern experimental work.

(2) The most original feature of Prof. Yerkes' book is its scope and arrangement. It is intended to be an introductory outline as distinguished from a manual, that is, to arouse interest and indicate the problems with which psychology deals rather than to give a systematic account of the main facts and theories. It has the defects as well as the qualities of this plan. On one hand it contains much interesting material not commonly to be found in elementary books. On the other, its treatment is of excessively varying thoroughness. Excellent features are the texts which head each chapter, consisting of quotations, often of some length, from some more advanced book or clever piece of research, and the practical exercises, intended, however, exclusively for class work, with which the chapters end.

Special topics of which the treatment seems less satisfactory are: the difficult question of the exact theoretical difference between introspection and "external perception"; the criticism of the "tripartite division" of consciousness; the use of "sentiment" in the sense of "an emotion which attaches itself to a particular object." A sentence on the final page is apparently incomplete.

(3) Prof. Starch's little book aims at providing a course of experiments in educational psychology for a small class, the work to occupy two hours weekly through one semester. For its purpose it seems to be excellent, though the verbal material of the experiments, having been selected from an

American point of view, occasionally requires adaptation for English students, *e.g.*, some of the test words in the chapter on apperception. This would be of little consequence were it not that the actual pages of the book are intended to be used in the experiments. In spite of this drawback, however, it will be found extremely useful by anyone in charge of, or wishing to form, an experimental class of the kind indicated.

AVIATION DYNAMICS.

(1) *La Théorie de l'Aviation, son application à l'Aéroplane.* By Robert Gaston. Préface de Maurice Farman. Librairie des Sciences aéronautiques. (Paris: F. Louis Vivien.) Price 1.50 francs.

(2) *Aëroplanes in Gusts.* Soaring Flight and the Stability of Aëroplanes. By S. L. Walkden. Pp. xv+188. (London: E. and F. N. Spon, Ltd., 1912.) Price 7*s.* 6*d.* net.

It is remarkable how many books have been written in connection with problems on aviation in which the principles of elementary dynamics have been ignored, misinterpreted, or otherwise misunderstood in a way that no candidate for an intermediate B.Sc. examination would believe to be possible. These two books afford excellent examples of this disregard of elementary principles.

(1) M. Robert Gaston, who has a highly flattering preface from Mr. Maurice Farman, finds that if a body is allowed to fall and then stopped at intervals of one second, its average velocity will be 4·9 metres per second (with $g=9·81$ m/s^2). If stopped more frequently its average velocity will be less, until we come to the case when it is being stopped at every instant—*i.e.* continually supported—when its average velocity is *nil*. Having definitely proved this, he contradicts himself by saying that to maintain a body in the air an upward velocity of 4·9 metres per second must be imparted, so that if the weight is W kilograms, the rate of working must be $4·9W$ kilogram metres per second. If he had adopted a minute, instead of a second, as unit of time, he would have found that the work required was $4·9W \times 60^2$ kilogram metres per minute, or sixty times his estimate; similarly, by taking an hour as unit he would have found a result 3600 times as great as he has estimated. Can anything be more absurd? Yet Maurice Farman congratulates him on the clearness and simplicity of his book!

(2) Mr. Walkden's main theme is based on a complete misunderstanding of the physical significance of the law of composition of accelerations. He measures the effect of a gust of wind by the accelerations of the air particles relative to the aëroplane, and by compounding this acceleration reversed with gravity he gets what he calls the resultant relative gravity. But the result means nothing at all.

The only effect which a gust of wind can have on an aëroplane is due to the pressures of the air on the surfaces and other parts of the aëroplane. These are in general functions of the relative velocity components of the air rather than the accelerations. The best that Mr. Walkden's method can do is to determine their *rates of increase*, not their actual values. To solve the problem of the aëroplane in gusts it is necessary, in the first place, to determine the six force and couple components of the air pressures as functions of the six components of relative linear and angular velocity of the aëroplane, and, having done this, to investigate the six equations of motion of the aëroplane under the action of these forces and couples. This book does nothing towards solving this problem, and, on the other hand, the appearance of such books is calculated to deter competent mathematicians and physicists from attacking such problems.

OUR BOOKSHELF.

Didaktik der Himmelskunde und der Astronomischer Geographie. Verfasst von Dr. Alois Höfler. Pp. xii+414. (Leipzig and Berlin: B. G. Teubner, 1913.) Price 12 marks.

This is the second volume of a useful series of handbooks which is appearing under the general title of "Didaktische Handbücher für den Realistischen Unterricht an Höheren Schulen," and arranged by Professor A. Höfler of Vienna and Professor F. Poske of Berlin. This volume follows that from the pen of the first named, which dealt with mathematical instruction, and its object, like its predecessor, is to reform the teaching of astronomy and astronomical geography in the schools. The volume is essentially for teachers and displays a graduated series of courses of instruction for students commencing when eleven years old and finishing at eighteen. The book is divided into four stages, each stage arranged to cover two years of the student's training. The author strives at great length to impress on the teacher the importance of leading the students to observe for themselves as much as possible, and to show them simple experiments whenever the opportunity arises.

No pains seem to have been spared to provide the teacher with numerous references to works that may be consulted by him, and to draw his attention to numerous points which are not often sufficiently clearly explained to the youthful student.

While the full course here suggested would be difficult to carry out under the conditions of education in this country, our teachers could nevertheless, provided they are sufficiently well conversant with the German language, gather a large amount of useful hints, even if only from the method of treatment of the material. For use in Germany we have no doubt that the teachers will hail gladly the appearance of this volume, and the distinguished list of co-workers with Prof. Höfler is sufficient indication to stamp the volume as one of a high order.

Einführung in die Agrikulturmykologie. By Prof. Dr. A. Kossowicz. 1. Teil: Bodenbakteriologie. Pp. vii+143. (Berlin: Gebrüder Borntraeger, 1912.) Price 4 marks.

Prof. Kossowicz is to be congratulated on having condensed into such a small book a review of the chief publications on soil mycology. The book partakes, in fact, more of the nature of an introduction to the literature of the subject than to the subject itself. The mere enumeration of the various workers for and against a hypothesis, without any criticism from the author, is not calculated to afford much help to a beginner. The subject-matter is divided into sections dealing with the part played by bacteria in the cycle of the elements carbon, oxygen, hydrogen, nitrogen, sulphur, phosphorus, and iron; the mycology of soil; the mycology of manure; and the influence of the manurial treatment on the micro-flora of the soil. For such a small book the bibliography is very comprehensive, constituting, as it does, about one-fourth of the total number of pages. The book is well illustrated, and as a short work of reference ought to prove of value to agricultural chemists and mycologists.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Piltdown Skull.

It had been my intention not to add anything further in print to my preliminary note (Quart. Journ. Geol. Soc., vol. lxix., 1913, p. 145) on the cranial cast obtained by Dr. Smith Woodward from his reconstruction of the Piltdown skull until I was in a position to make a full and comprehensive statement as to the precise significance of the information afforded by the cranial fragments as to the kind of brain possessed by the earliest known human inhabitant of Britain. But, although my investigations are now sufficiently advanced to permit me to undertake the writing of my report, it will be some months before it can be published; and in the meantime it is most undesirable that the present widespread misunderstandings should be allowed to breed further trouble and confusion for those who are interested in the elucidation of Mr. Charles Dawson's momentous discoveries.

Recent events have made it difficult for those who have relied wholly upon what has appeared in print to form any accurate conception of the meaning and importance of the Piltdown skull-fragments. It is quite certain that they afford the first evidence we have obtained of a hitherto unknown group of the Hominidæ, so fundamentally distinct from all the early fossil men found in Europe as to be worthy of generic distinction—a "dawn-man" of a very primitive and generalised type. Certain features are so clearly ape-like as definitely to confirm the generally admitted kinship to the African anthropoid apes, as well as to distinguish Eoanthropus sharply and clearly from all other human remains. In other respects, however, there is a closer resemblance to the features of modern man than is found in the specialised group of Neanderthaloid palæolithic men. This curious association of features is not paradoxical, as some people pretend. The small and archaic brain and thick skull are undoubtedly human in character, but the mandible, in spite of the human molars it bears, is more simian than human. So far from being an impossible combination of characters, this association of human brain and simian features is precisely what I anticipated in my address to the British Association at Dundee (Nature, September 26, 1912, p. 125), some months before I knew of the existence of the Piltdown skull, when I argued that in the evolution of man the development of the brain must have led the way. "The growth in intelligence and in the powers of discrimination no doubt led to a definite cultivation of the æsthetic sense, which, operating through sexual selection, brought about a gradual refinement of the features." Just as the young child still uses its teeth for purposes of attack, so in the dawn of human existence teeth suitable for offensive purposes were retained long after the brain had attained its distinctively human status and had made the hands even more serviceable instruments for attack.

That the ape-like conformation of the chin region signifies the inability to speak is surely a patent fallacy. Articulate speech must have come while the jaws were still simian in character; and the bony changes that produced a chin were the result mainly of that process of refinement to which I have already referred, to the reduction of the teeth, which was part of the same process, and, quite in a minor degree, to that process of growth and specialisation of the genio-glossi muscles which resulted from their use in speech.

A great source of misunderstanding will be got rid of if these obvious facts and the considerations based upon them be admitted.

In conclusion, I may answer many questioners by affirming that I still hold to every word of my preliminary note published in the Quarterly Journal of the Geological Society, as well as of the statements made in my lectures delivered before the Royal Dublin Society and the Manchester Literary and Philosophical Society last winter, and also to the facts demonstrated in my exhibit at the Royal Society's soirée in May.

G. Elliot Smith.

University of Manchester, September 23.

Solar Electrical Phenomena.

In a lecture last January to the Christiania Academy, Prof. Birkeland[1] gave an interesting summary of his recent researches on solar and planetary electrical phenomena. He describes how in a study intended to elucidate the evolution of celestial bodies he examined the nature of the electric discharge taking place *in vacuo* in a large discharge vessel from a magnetisable globe serving as kathode. The experiments, which were made under widely differing conditions, were on a scale more ambitious than anything hitherto attempted. Two vessels of 300 and 1000 litres' capacity respectively were employed. In the larger of these the globe used was of 36 cm. diameter,

[1] "De l'origine des mondes," par K. Birkeland, Arch. Sci. phys. et nat. Genève. Quatrième Periode, t. xxxv., Juin, 1913.

and discharges up to nearly half an ampere were obtained. Some of the published photographs are very remarkable. One of them showing the electric corona and streamers round the magnetised globe might easily be mistaken for a genuine photograph of a typical solar eclipse. Many of the phenomena of sunspots are also very strikingly imitated in the experiments.

Birkeland proceeds to discuss the cause of the general magnetic field of the sun, the fact of the existence of which has been established by Hale. He attributes it to induced currents circulating in the interior of the rotating mass, which, he argues, can only have a comparatively feeble electric conductivity. He says (*loc. cit.* p. 540):—

"We know that electric currents circulating in large globes formed of good electric conductors are of great persistence. Lamb found that for a globe of copper as large as the earth, ten million years would elapse before the currents fell to $1/\epsilon$ of their former intensity. The induction effects produced by electric rays emanating from sunspots may therefore give rise to currents of long duration if circumstances permit. It is probable that as regards the sun, we shall be obliged to suppose a somewhat feeble conductivity of the gaseous interior, to the intent that the electric currents created and circulating within it are reduced with a fairly high rapidity and are transformed into heat."

In a recent communication to the Royal Astronomical Society,[2] the writer brought forward some evidence deduced from laboratory experiments, which led to a contrary conclusion, namely, that the gaseous matter composing the sun must be a highly conducting medium. The experiments of Kaye[3] and the writer showed that carbon and a number of metals emit on heating ionisation currents of a relatively very high order of magnitude, and this in absence of any external applied potential and at atmospheric pressure. The currents are almost certainly carried by swarms of negatively charged particles of relatively considerable mass, the emissivity of the emitting surface increasing very rapidly with increase of temperature.

In the interior of a carbon-tube resistance-furnace heated by alternating current, the apparent gaseous resistance of the order of megohms at 1400° C. fell at the highest attainable temperature to a small fraction of an ohm, due to the emission from carbon alone. In one series of experiments where temperature measurements were made, the conductivity increased exponentially nearly two hundred-fold for each rise of 1000° C. Impurities such as iron and silicon, which are generally present in ordinary samples of carbon, may further increase the conductivity four or five fold during the first heating of a new furnace. Though influenced somewhat by the surrounding gas, the emissivity appears to be invariably present in neutral or reducing media. The experiments of King, briefly referred to by Hale in his paper in the current number of *The Astrophysical Journal*, show that though the emissivity of carbon falls with increase of pressure, it is still apparent at 20 atmospheres.

Seeing that the temperature of the sun is probably between 5600° and 6000° abs. and that of those elements shown to possess an appreciable electric emissivity, carbon, and iron at any rate are present in the solar atmosphere in considerable quantity, it is difficult to avoid the conclusion that the degree of ionisation, and consequently of electric conductivity, must be very high; probably at least as good as that of the globe of copper considered in Lamb's computation.

The bearing of these conclusions on Birkeland's solar theory seemed worthy of some consideration.

J. A. Harker.

Teddington, September 16.

[2] Harker, "On the Origin of Solar Electricity." Monthly Notices of the Royal Astron. Soc., June, 1913.

[3] Harker and Kaye "On the Emission of Electricity from Carbon at high Temperatures." Proc. Roy. Soc. A. vol. lxxxvi, 1912, pp. 379 to 396. "On the Electric Emissivity and Disintegration of Hot Metals." Proc. Roy. Soc. A. vol. lxxxviii, 1912, pp. 522 to 538.

A New Aquatic Annelid.

About the middle of September I received from Dr. H. F. Parsons, of Croydon, a fresh-water Annelid which had been found in the water supply of Ringwood, Hants, and sent to the Local Government Board for identification. It proved to be an immature but very beautiful specimen of *Rhynchelmis limosella*, Hoffm., a member of the Lumbriculidæ. It is of peculiar interest, inasmuch as it confirms a suspicion expressed by Beddard in 1895. He remarks ("Monograph of the Order Oligochæta," p. 215) that "the genus Rhynchelmis is, so far as our present knowledge goes, confined to the fresh waters of Europe. . . . I have seen a specimen from some part of England, but cannot give any details. I believe this specimen to be in the Oxford Museum. There is every probability that it is a native of this country."

I have collected annelids in almost every part of the British Isles, but hitherto have never had the good fortune to come across the species here named. It is, therefore, very gratifying to be able to record it as a new addition to our Annelid fauna.

Hilderic Friend.

Pocklington, York, September 20.

MODERN ELECTROMETERS.

Recent research on the electron and radioactivity has necessitated so many refined electrostatic measurements that much attention has been directed to the design of electrometers, and several different instruments distinguished by their sensitiveness and convenience in working have been devised. Two types have served as the starting-points for modern improvements, the first being the gold-leaf electroscope, and the second the quadrant electrometer of Lord Kelvin; great progress has been made by bettering the insulation, the sensitiveness, and the accuracy and ease of observation, and further by important modifications of design. Polished amber or ambroid, a substance made from compressed fragments of amber, is now generally used as insulating substance, and for the first type of instrument the deflection is now measured with a reading microscope; for the second the mirror and scale is employed.

The gold-leaf instrument is used in many forms. In a modification by Exner a leaf is fastened on either side of a narrow, vertical, insulated metal plate, while opposite each leaf is a metal plate the distance of which from the central plate can be adjusted, thus controlling the sensitiveness; for potentials of some hundred volts this is a convenient form. For higher potentials of thousands of volts Braun's pattern, with a light rigid needle pivoted a short distance above its centre of mass, is much used. For very sensitive measurements C.T.R. Wilson has recently modified the gold-leaf electroscope in his so-called "tilted electrometer." In this instrument a single hanging gold leaf is attracted out of the vertical by an inclined insulated plate, which is kept charged at a constant potential. On varying the inclination of the plate by tilting the instrument, a position can be found for which the leaf is only just in stable equilibrium; slightly increasing the tilt would cause the leaf to fly over to the plate. In such a case, as is well known, the sensitiveness of an instrument is very high, a familiar example being the suspended magnet galvanometer, in which, by adjusting the field magnet, the controlling field is so arranged that the magnet is only just in stable equilibrium. The capacity of this instrument of Wilson's is very small, and a reading microscope attached to the stand enables accurate readings to be taken. Fig. 1 shows in section the instrument as made by the Cambridge Scientific Instrument Co.

To avoid difficulties, known to all physicists, which occur in working with a gold leaf, Wulf

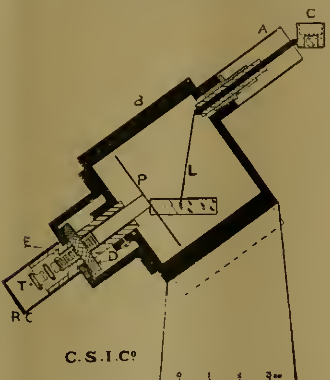

FIG. 1.—The tilted gold leaf electrometer.

has devised a very effective instrument, put on the market by the firm of Günther and Tegetmeyer, in which the leaf is replaced by quartz fibres rendered conducting by sputtering with a thin film of platinum in a kathode-ray tube. Two such fibres hang side by side, loaded with a minute weight: on being charged the fibres repel one another, and the separation is read with a microscope. The fibres give a very sharp image, and thus all difficulty connected with reading by one irregular edge of a gold leaf is avoided. The capacity is smaller than that of the smallest leaf instrument, and practically independent of the potential. The sensitiveness never approaches that of the tilted electrometer, but this instrument is excellent for measuring potentials of either a few volts or a few hundred volts, according to the fineness of the fibres, the size of the weight, and other details of construction. It fills the gap between the tilted and the Braun electrometer, and is very convenient and portable. A somewhat similar design is the Einthoven string electrometer, in which a silvered quartz fibre is stretched between, and parallel to, two metal plates, kept at a constant difference of potential.

The pattern of quadrant electrometer devised by Dolazalek is so widely used at present that it suffices to mention very briefly the improvements introduced, the small dimensions of the needle and quadrants, the quartz suspension, the amber insulations, and the light needle of silvered paper, rendered rigid by its peculiar form. Dolazalek has, however, recently devised an instrument differing in many important particulars from that familiar to English physicists, which he calls the binant electrometer, from the fact that the four

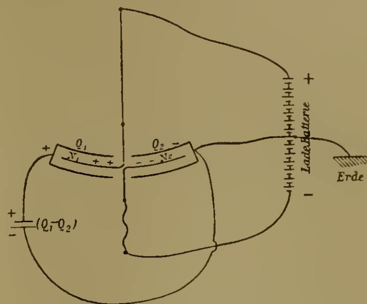

FIG. 2.—The binant electrometer.

quadrants are replaced by two semicircular "binants"[1]; it is made by Herr Georg Bartels, of Göttingen. This instrument has many advantages over the quadrant pattern, and is being widely used in Germany, although at present it seems to be unknown in England. The "needle" is a disc formed of two semicircular segments of the thinnest sheet-aluminium, stiffened by means of embossed ridges, and insulated from one another with amber. The box which encloses them is likewise made up of two semicircular parts supported on amber, arranged so that their line of separation is perpendicular to the line of separation of the needle segments. Needle and box are not plane, but formed from shallow concentric spherical shells, the centre of which coincides with the point of suspension of the needle. Owing to this simple device an oscillation of the needle does not bring it any nearer to the enclosing walls, and the needle is stable at very much higher potentials than in the case of the quadrant electrometer; this form also lends increased rigidity to the delicate needle. When in use, one of the segments of the needle is charged positively, the other negatively, by earthing the middle of the battery used for charging; contact is made for the one segment through the suspension, which is an exceedingly fine Wollaston wire, and for the other through a still finer coiled wire arranged

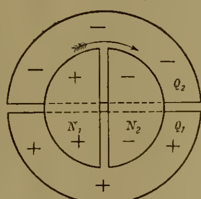

FIG. 3.—The binant electrometer. Plan.

[1] "Annalen der Physik," (iv) 26, 1908. F. Dolazalek, "Binantelektrometer." Figs. 2, 3, and 4 are from this paper.

in a similar way to the lower connection in a moving-coil galvanometer. The binants of the box are connected to the potential difference to be measured.

Advantages of the instrument are the wide proportionality between deflection to one side and potential difference, and the large range of potential which may be given to the needle with satisfactory results; in addition we have the stability of the needle already mentioned. The deflections to one side are proportional to the applied potential difference over a range seven times as great as is the case when, with the quadrant instrument, readings to both sides are taken. This property has led to the construction of a portable binant instrument with a pointer, which can be used as a voltmeter, measuring directly potentials to a fraction of a volt without passage of current. If used idiostatically, the deflections are, of course, proportional to the square of the potential, and, connected in this way, the instrument measures alternating potentials very effectively.

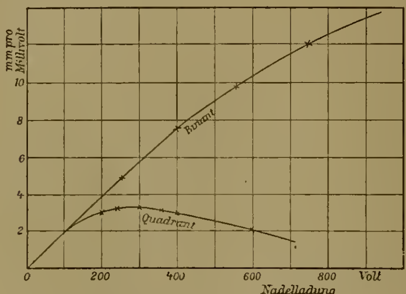

FIG. 4.—The sensitiveness of the "binant" and quadrant electrometer compared.

The potential of the needle in the binant instrument can be taken as small or as large as may be desired. The variation of the sensitiveness with the potential of the needle is shown in the diagram (Fig. 4) for a quadrant and a binant instrument of similar dimensions throughout. The abscissæ are the difference of potential of the two halves of the needle for the binant, the potential of the needle above earth for the quadrant, and the ordinates are millimetres deflection per millivolt applied potential. With the binant form the deflection is proportional to the potential of the needle up to about 400 volts, and still continues increasing up to 1500 volts (off the diagram); in the case of the quadrant instrument the sensitiveness increases slowly with the potential of the needle, and reaches a maximum at about 300 volts, after which increasing the potential of the needle is disadvantageous. Further, for the quadrant electrometer the potential of the needle cannot be taken very small, as in this case the readings are too asymmetrical on reversal, as will be seen from the ordinary formula of the text-books. For the binant the potential of the needle may be taken as small as desired; in fact, by altering the potential of the needle alone measurements of potential can be made over a region of five powers of ten.

The cause of the peculiar variations of the sensitiveness of the quadrant electrometer with the potential of the needle, increasing to a maximum and then decreasing again, is to be found in the fact that the change of capacity per unit angular displacement is not constant, as assumed in Maxwell's accepted treatment, but decreases with increasing needle potential and increasing displacement. This is due to the lines of force from the radial edges of the needle, which are to a large extent diffused not perpendicularly to the top and bottom of the box, but horizontally. The connection of such horizontal lines of force with one of the quadrants is unaltered by the displacement of the needle, and this influences the changes of capacity. The form of the needle and its position avoid these disturbances in the binant instrument; the narrow gap between the two halves of the needle, and their opposite potentials, cause the lines of force from the diametral edges to spring from one half to the other, instead of to the walls of the box, and the position of the gap perpendicularly to the gap in the box further diminishes the effect. The wide proportionalities of the binant electrometer are largely attributable to this result of its peculiar construction.

E. N. DA C. ANDRADE.

THE TECHNICAL PRODUCTION AND UTILISATION OF COLD.[1]

THE appearance of an English translation of the work by Georges Claude (1), the successful French inventor in the field of the liquefaction and rectification of air, affords an occasion for reviewing the progress made in this, which seems destined to become one of the leading departments of twentieth-century scientific industry. Eighteen years have elapsed since the inventions of Linde and Hampson solved the problem of the production of liquid air in quantity, and extended the range of low temperatures practically attainable to as great an extent as the electric furnace did in the opposite direction. It is sufficient to recall the names of Faraday, Andrews, Dewar, Hampson, and Ramsay to show that this country has not been behindhand in pioneers in this field, both in regard to the attainment of low temperatures and to their utilisation for scientific investigation. But there, as in other cases, progress in this country seems to have come to a standstill, and the commercial application and utilisation of these results has been developed entirely abroad, in this case chiefly in Germany and France.

It is on this side of the subject that the present book furnishes much information difficult to acquire easily elsewhere. Part i., dealing with elementary principles and the history of the subject, and part iii., with the properties of liquid

[1] (1) "Liquid Air, Oxygen, Nitrogen." By Georges Claude. Translated by H. E. P. Cottrell. With a Preface by D'Arsonval. Pp. xxv.+418. (London: J. and A. Churchill, 1913.) Price 18s. net.
(2) "Le Froid industriel." By L Marchis. Pp. xx+328+104 figs. (Paris: Félix Alcan, 1913.) Price 3.50 francs.

air, are popular presentations of a hackneyed theme, almost painfully familiar in this country, where liquid air long since descended to the level of a music-hall turn. But in parts ii. and iv. the author deals in an interesting and original way with the theory and practice of actual processes for the technical liquefaction of air, and its separation into oxygen and nitrogen. Naturally an author must be allowed to tell his story in his own way, and fight his battles over again, when these battles have resulted in success, though almost everyone may now be supposed to know that working at $-200°$ C. does not confer upon liquids any peculiar behaviour or render the separation of oxygen and nitrogen from the air a problem essentially different in its scientific principles from that of the separation of alcohol and water in one of the oldest of chemical operations.

The English translation certainly retains to the full the racy style of the original, but sadly needs careful revision, especially in the mathematical expressions. As many as six slips have been noted, for example, on pp. 132-4. The units employed should be defined to render them intelligible to English readers, and misleading contractions like *calorie* for *kilogramcalorie,* and *Kgms.* for *Kilogram-metres,* avoided. In more than one instance the real meaning of the author, just where it is important, is obscured by some slip or looseness of expression, as on p. 184, where an improvement is stated to increase the yield of liquid air in Claude's process *by* 0·85 litre per H.P. hour, when apparently *to* 0·85 litre is intended. In a preface by D'Arsonval yields of "finally 0·95 litres per H.P. hour" in Claude's process are referred to, but in the text, apart from the above imperfect statement, we are left in doubt as to the best that Claude has so far been able practically to achieve.

Dealing first with the problem of air liquefaction Claude's especial contribution is the solution of the problem of expansion with external work, following the suggestion made by Lord Rayleigh so long ago as 1898. As is well known, Linde's and Hampson's processes depend only on the "internal work," that is, on the relatively minute cooling effect—the Joule-Thomson effect—produced on the expansion of an imperfect gas, like air, due to the work done by the molecules in increasing their distances apart against their own feeble attraction. As in the whole of these processes, the Siemens exchanger of temperature, fifty-six years old, is employed, and enables this cooling to be used regeneratively until ultimately the liquefaction temperature is reached. But at the expansion jet, or, at least, inside the exchanger, just where it is emphatically not wanted, the enormous mechanical energy of the escaping gas is quantitatively reconverted into heat. The expansion is adiabatic, and temperatures, as in Cailletet's apparatus, far below the liquefaction temperature are instantaneously attained, but, in distinct inferiority to Cailletet's simple process, are not made use of because the work is quantitatively reconverted into heat inside the system. At first sight, but at first sight only, it appears that an enormous improvement might be effected in this direction, increasing the yield of liquid air some ten times, and regaining thereby a substantial proportion of the work employed in compression. Lord Rayleigh's suggestion was that the air on expansion should drive a turbine, which, however inefficient, could not fail both to increase the cooling effect and recover some of the power employed.

Claude has successfully employed the energy of expansion to do work in a compressed air motor capable of working below $-100°$ C. We read that "while the makers have troubles, which are relatively frequent, with the ever well-known but still somewhat barbarous and brutal appliances which air compressors are, they have, so to speak, none at all with the new-born appliances, the expansion machines for liquid air." At first petrol and even liquid air itself were employed as lubricants in the cylinders of the compressed air machines. Lubrication troubles seem, however, now to have been entirely avoided, owing to a discovery (1912) of the unique properties of leather, which, after being suitably treated, preserves all its good qualities at low temperatures. In the present machines the pistons of the expanders are provided with stamped leathers instead of metallic rings, and do not require any lubrication. The chief advantage of the system is that lower pressures—40 atmospheres, the critical pressure of air—can be employed, whereas the Linde and Hampson processes depend on the use of a pressure of 200 atmospheres. But the yield, spoken of in the preface as finally 0·95 litre per H.P. hour, is not very greatly superior. In the Linde process a practical yield of 0·6 litre per H.P. hour is realised in large machines, which is some three times better than in the Hampson laboratory machine.

The evolution of Claude's system has many points of interest. Exchangers are employed, and the gas arrives at the expander at a temperature of about $-100°$ C. Now if this process of exchange is carried too far, for example to $-140°$ C, "the air which enters the machine is not yet a liquid, but it is almost no longer a gas; its expansive properties are, so to speak, done away with, and the external work of expansion becomes detestable." Even were air a perfect gas, it can readily be seen that the more it is cooled before expansion the less energy it has to lose when expanded, and the smaller the cooling effect obtained. Enormously more of it is required to fill the cylinder the lower the temperature, whilst all the time the external work it can do, and the cooling effect it can produce, are steadily vanishing. But actually, at $-140°$ under 40 At., the volume is already only one-fourth of that of a perfect gas. This, of course, though Claude does not say so, is tantamount to admitting that the defect in the "internal work" processes in not utilising the energy of expansion is more apparent than real, and that the advantages of utilising the external work are to a large extent illusory. The practical solution was found in admitting the compressed gas to the expander at a temperature as high as is consistent with the attainment of a final temperaure below the critical temperature. This is effected by passing the cold expanded air at about $-140°$ around tubes supplied by a T branch from the intake of the machine, *i.e.* with air at 40 At. and at $-100°$ C. It liquefies part of this compressed air, and is warmed up thereby to about $-130°$, at which temperature it is admitted to the exchanger. A further improvement is obtained, much as in multiple expansion steam engines, by expanding in stages and warming up the expanded gas in between by making it circulate over coils filled with air above its critical pressure.

Thus at the present time liquid air may be produced in large machines for an expenditure of power perhaps one-fourth to one-fifth of that required in the Hampson simple laboratory machine, but it must still be regarded as a somewhat expensive and troublesome commodity to base a process upon. Naturally the question arises how it is that such great results may be confidently anticipated of its use. It has already displaced all other processes for the production of oxygen and nitrogen on a large scale, and, in the same field, the preparation of pure hydrogen and carbon monoxide from water gas offers no insurmountable difficulty. The industry can supply oxygen to-day, in plants of 1000 cubic metres per hour, at 0·2*d*. per cubic metre, and this means that to burn coal in pure oxygen rather than in air would increase the cost of the fuel only some four times. The saving in certain cases, through not having to heat at the same time a mass of nitrogen at least two and a half times greater than that of the coal and oxygen together, is evident. But this to-day's figure gives no conception of what could be done if chemists really set themselves to separate the oxygen and nitrogen of the atmosphere before use, even in such common processes as the combustion of fuel. It can be stated confidently that the cost of the oxygen would not exceed that of the coal, without taking into account the possible use of the nitrogen produced at the same time. When it is considered how all industrial chemistry has been based upon the necessity of taking oxygen always diluted with some five times its volume of nitrogen, the revolution in methods that these facts suggest is obvious. A blast furnace, for example, consuming oxygen instead of air, would be very different from the present affair.

The reason why the liquefaction of the atmosphere and its subsequent rectification holds out such great industrial possibilities, in spite of the somewhat expensive character of liquid air, is, of course, that the cold is used regeneratively. There is an apparatus into which air at ordinary temperatures passes, and out of which oxygen and nitrogen, at a few degrees only from that temperature, issue. In other words, the losses of cold through the issuing gas being at slightly lower temperature than the entering gas are so small that in the rectification of thirty litres of liquid air into its components some twenty-nine litres would be recovered. Actually, there is a very slight expenditure of power required, amounting theoretically to 0·1 H.P. hour per cubic metre of oxygen separated. In addition, the losses through heat entering the well-insulated apparatus from outside must be considered, but these, naturally, are the smaller the larger the scale of operations. The yield of pure oxygen, the nitrogen being left with 2·4 per cent. of oxygen, per H.P. hour is, for a plant of 50 cubic metres per hour, about 1 cubic metre; of 100 cubic metres per hour, 1·2 cubic metres. For larger plants 1·5 cubic metres is confidently predicted. For the purpose of the industries fixing atmospheric nitrogen, naturally, great purity of the nitrogen rather than that of the oxygen is aimed at, and in these a purity of 99·9 per cent. can be realised, the oxygen testing some 80 per cent.

Space does not permit any detailed discussion of the factors which have enabled the older Linde process to compete successfully, and now to cooperate with, the newer processes utilising the principle of external work, though, as admirably set forth in this book, these are fascinating enough. Nothing less than real genius could have enabled Linde eighteen years ago to grasp and work out the intrinsic possibilities of success in the "internal work" method, which appears theoretically to be so barbarously wasteful, or to have designed the apparatus which, as Claude remarks, strikes one at first sight like a coach with five wheels. It furnishes a most interesting example, in this region of topsy-turvy thermodynamics, of how thoroughly the theoretical aspect of a problem may change the more deeply and completely it is examined.

(2) The volume by Prof. Marchis is complementary to the other, and does not deal with the production of the extreme temperatures necessary for the liquefaction of air. It gives a most readable and useful account of the science of refrigeration as applied to the preservation of perishable commodities. It is packed full of practical information about refrigerating machines and insulating materials, the construction and management of cold-storage chambers and ice factories, and the preservation of the great variety of comestibles dealt with nowadays, each of which requires its special treatment if the best results are to be attained. The book can be confidently recommended as being in itself almost sufficient for an engineer without experience to undertake this field of work. At the same time, it contains much recent information of general utility to all interested in the subject. A description of the recent high-speed rotary compressors of M. Leblanc, with vanes of ramie fibre, agglutinated by the solution of acetate of cellulose in acetone, and running in a casing with practically no play at a peripheral speed of 500 metres per second, ends an abundantly illustrated section dealing with the various types of refrigerating machines. In the last two chapters the special cases of the preservation of meat and of fish are treated in detail. The author combats the prevalent idea that cold storage

tends to make food go bad more quickly when it is re-exposed to the ordinary temperature. Cold does not improve articles already commencing to decompose; but, on the other hand, if scientifically carried out—that is, if the food is in excellent condition to begin with, and is preserved with all due precautions as regards the correct temperature, its uniform maintenance, and the proper hygrometric condition and frequent renewal of the air in the store-room, and if the lowering and raising of the temperature do not take place too suddenly—no harmful consequences follow refrigeration.

F. SODDY.

THE NATURAL HISTORY OF A LONDON SUBURB.[1]

THE increasing demand for works on local natural history, of which class of publication the present volume is an excellent specimen, must have been noted by workers in science as a healthy sign of popular awakening. But while in the eighteenth century it was possible for a Gilbert White to cover the whole ground so far as concerned his own district, the great development of specialised knowledge in modern times necessitates the cooperation of many workers to produce such a volume as that under consideration. Thus, in addition to the opening chapter on topography, by Messrs. Maynard and Findon (the hon. sec. of the natural history section of the society), there are ten chapters by different authors dealing respectively with the geology, climate, plant-life (three chapters), bird-life, mammals, &c., insects, molluscs, and pond-life together with a very useful bibliographical appendix.

A commendable feature of the present work is the general introductory section heading many of the chapters. By this treatment the reader is enabled to pass from the general to the special—a method which may be condemned by some critics as an inversion of scientific method but, in a local natural history, has the distinct advantage of enabling the general reader and the would-be student to realise that the local and restricted data supplied by his own district fit in to the larger and more comprehensive generalisations which scientific observers have built up from detailed observations over wider fields. The chapter by Mr. A. G. Tansley dealing with the vegetation (chap. iv.) is a very good example of the treatment referred to, as he begins with the ecology, shows the relationship of the vegetation to the geological features, and then groups vegetation generally under the various types of "associations" before dealing with the particular plant-associations of the district. The lists of species then come as natural sequences to the various "associations." A living interest is thus imparted to a subject which in former times was presented

Badger Earths in Ken Wood. From "Hampstead Heath: Its Geology and Natural History."

in the uninteresting form of a catalogue of names, amounting, in fact, to nothing more than the statement of the occurrence of a certain species in a particular district, without any relationship to its environment or to its associates. The chapter on the trees and shrubs (chapter v.), by Mr. Hugh Boyd Watt, will surprise many readers as a revelation of the extreme richness of the district, all

[1] "Hampstead Heath: Its Geology and Natural History." Prepared under the Auspices of the Hampstead Scientific Society. Pp. 328+xi plates+3 maps. (London; T. Fisher Unwin, n.d.) Price 10s. 6d. net.

the native English trees, and also a large number of foreign species, finding the conditions suitable for their growth. How long these conditions will remain favourable is problematical, a remark which applies also to Mr. Whitton's goodly list of some 300 species of flowering plants given in chapter vi.

The geology of the district is necessarily "tame," but since Mr. F. W. Rudler is responsible for that chapter (chap. ii.), it is perhaps scarcely necessary to say that it will be found both interesting and instructive. The only regret is that the author did not "let himself go" more freely in discussing some of the generalisations which have of late years been based upon the detailed study of gravels and superficial deposits generally. In connection with the climate of Hampstead (chap. iii., by Mr. E. L. Hawke), it is of interest to note that the sunshine record, as compared with that of the city, more nearly approaches that of Berkhamstead, which is tolerably clear of London influence. Thus the total number of hours of bright sunshine during 1910 was 1372, as compared with 1348 at the Hertfordshire station, 1183 at Camden Square, and 993 at Bunhill Row. So much for the effects of atmospheric pollution in the City of London! Bird-life (chap. vii.) is dealt with by Mr. Herbert Goodchild, who gives a very clear account of the particular conditions favourable and unfavourable to an avifauna. One of his observations is very significant: "Adjoining the heath are several private woods, a form of ownership which tends to the preservation of species that might otherwise be lost to the district, since in such woods and coppices the birds are safer from molestation. As some of these woods adjoin the public domain, an observer may see on the latter many species of birds that might be driven away if all the woods were public." The writer of this notice has long ago come to the conclusion that the preservation of open spaces solely from the point of view of the "recreation and enjoyment of the public" is in many cases quite the reverse of a boon from the point of view of the naturalist. Mr. Goodchild is, of course, an advocate of the study of bird-life by the modern method —*i.e.* the field-glass and camera, and not by the gun. It is fortunate for the district, also, that it comprises the Brent reservoir, and that that well-known observer Mr. J. E. Harting was a former resident, and kept observations of the birds for many years.

The chapter on mammals, fishes, and reptiles, by Mr. Hugh Findon, will also surprise many readers who are unprepared for the survival of such a number of species within sight of the metropolis. The existence of badger-earths, still apparently tenanted, is certainly remarkable, but here, again, the preservation of this notoriously shy animal is due to the inclusion of the earths (a figure of which we reproduce) in the private grounds of Ken Wood, the owner of which estate has always been a sympathetic conservator of this interesting denizen. Dr. O'Brien Ellison's chapter on insect-life serves to emphasise the complaint so frequently made by entomologists in this country that local collectors so generally concentrate their attentions upon the Lepidoptera to the neglect of other orders. There are surely more than twenty-seven species of Coleoptera in the district, to say nothing of Hymenoptera, Diptera, and Microlepidoptera. The list of Lepidoptera, by the way, is marred by a number of misprints. It only remains to add that there are chapters on molluscs and on pond-life by Mr. Hugh Findon and Mr. James Burton respectively.

The Hampstead Scientific Society has certainly done good service in publishing this volume, which is a typical specimen of the kind of work which local societies should undertake. For a district such as that dealt with—viz. within the three-mile radius from the flagstaff on the summit of the heath—a book like that before us is not only of immediate utility, but is certain to acquire increased value as time moves on and the influence of urbanisation becomes more and more pronounced. Already many of the species recorded are taken from old publications, and are now extinct. The general impression produced by the perusal of the volume is one of marvel at the persistence of so much that is "natural" in the area described.

R. M.

PROF. HUGH MARSHALL, F.R.S.

BY the untimely death of Prof. Hugh Marshall, which took place in London on September 5, chemistry has lost, at the early age of forty-five, one of the nowadays comparatively few prominent men who devoted their energies to the investigation of subjects connected with the inorganic and mineralogical branches of the science, and the University of St. Andrews an active and useful member of the professorial staff of Dundee University College.

It is not a disparagement to say that Dr. Marshall's most brilliant discovery—that of the persulphates, in 1891—was due to one of those fortunate chances, not infrequent in science, where experiments designed to elucidate a certain definite question lead to some new discovery of a wholly different description and often of much greater consequence; for, no sooner was the discovery made than its author was quick to discern that substances of far-reaching importance had fortuitously presented themselves to him and to prosecute their examination with exceptional vigour and success. The subject under immediate investigation was the oxidation of cobalt salts by electrolysis in the then comparatively little employed "divided" electrolytic cell, and on passing a current of electricity through "a fairly acid solution of cobalt and potassium sulphates," with a view to prepare potassium cobalt alum, small crystals slowly separated, which proved on analysis to consist of potassium persulphate. The discovery of the persulphates at once brought Dr. Marshall's name into prominence, while the assiduity and skill with which he continued his examination of them speedily marked him as a rising inorganic chemist.

Having a distinct leaning towards mineralogy and crystallography, he devoted a considerable amount of study to these subjects also, and published several useful crystallographical papers; but inorganic chemistry claimed most of his attention, and his later papers as a rule savoured more or less of persulphates in some of their varied interactions. Thus, either alone or in collaboration with others, he published papers describing the action of persulphates on iodine, silver salts, thiosulphates, &c.; and the neat modification of Crum's test for manganese, in which potassium persulphate is employed as oxidising agent instead of lead peroxide, was devised and elaborated into a quantitative colorometric method by him. Other papers dealt with thallic sulphate; rubidium, cæsium, and thallium persulphates; quantitative analysis by electrolytic methods; succinic acid and succinates; the compound of iodine with thiocarbamide, &c.

In addition to his chemical investigations he found time to examine some technical subjects, and his work upon the burning of mixtures of air and light hydrocarbon vapour led to the perfecting of the "Petrolite" safety incandescent lamp, for which he was awarded prizes by the Edinburgh Association of Science and Art, and the Royal Scottish Society of Arts. He also devised a simplified form of Bunsen burner which was particularly suitable for use by beginners in laboratory practice. The Keith prize and gold medal for the period 1899–1901 was awarded to him by the Council of the Royal Society of Edinburgh for his researches on persulphates. He was elected to fellowship of the Royal Society in 1904, and to the chair of chemistry in Dundee in 1908. With, to all appearance, many years for good work still before him, Dr. Marshall was a man whom inorganic chemistry could ill afford to lose.

LEONARD DOBBIN.

NOTES.

REUTER'S Agency is informed that Sir David Bruce will leave England on November 1 for the purpose of concluding his sleeping sickness investigations in Central Africa. He will be accompanied by Lady Bruce, who is herself a member of the Commission. Sir David and Lady Bruce will sail in the *Edinburgh Castle* from Southampton, and will proceed to Cape Town, whence they will travel by train to Beira. From that place they intend to go up the Zambesi and Shire rivers to Lake Nyasa.

The Paris correspondent of *The Times* reports the death of the toxicologist, Dr. Jules Ogier, at sixty years of age. Our contemporary gives the following particulars of Dr. Ogier's career:—After some years' work with Berthelot, during which period his writings on arsenic and other poisons attracted considerable attention, he was appointed director of toxicology at the Prefecture of Police, where his work was of the greatest value to justice. He planned most of the large water systems in France, and his labours in connection with the purification of drinking water have been of great service to public health. He was in a way the creator of modern toxicological chemistry, and his many works include a treatise which has become a classic in that branch of science.

THE seventeenth annual autumn foray of the British Mycological Society was held at Haslemere on September 22–27, the Haslemere Educational Museum, founded by the late Sir Jonathan Hutchinson, serving as headquarters during the meeting. A well-arranged programme of excursions was planned by Mr. E. W. Swanton, and a large number of fungi were collected, including many rare and interesting forms. The mornings were generally devoted to the examination and arrangement of specimens, some of the most noteworthy of which were:—*Rhizopogon rubescens, Hydnum melaleucum, H. Queletii, Sparassis laminosa, Clavaria formosa, Cortinarius bolaris, Mycena crocata*, and *Sclerotinia baccarum*, and also the Mycetozoa, *Licea pusilla, Hemitrichia clavata, Oligonema nitens*, and *Diderma simplex*. On Wednesday evening, September 24, Mr. A. D. Cotton (president for the year) delivered an address entitled "Suggestions as to the Study and Critical Revision of Certain Genera of Agaricaceæ," pointing out the urgent need of critical work, and emphasising the diagnostic value of certain microscopic characters. Other members contributed papers, namely, Mr. F. T. Brooks, on pure cultures of several Basidiomycetes and Ascomycetes; Prof. Buller, on the hymenium-structure in Hymenomycetes; and Mr. J. Ramsbottom, on the history of the classification of Discomycetes. In passing a vote of thanks to the trustees of the museum, the hope was expressed that the scientific and educational work hitherto carried on there would be continued, and that it would be possible to establish the museum upon a permanent basis. The officers elected for 1914 were:—President, Prof. A. H. R. Buller; vice-president, Miss G. Lister; honorary secretary and treasurer, Mr. Carleton Rea; the localities for the spring and autumn meetings being the Forest of Dean and Doncaster respectively.

AT a conference held on September 19 in the rooms of the Linnean Society, Burlington House, Dr. A. B. Rendle, F.R.S., gave an account of the inception and activities of the plant protection section of the Selborne Society, under the auspices of which the meeting had been called, and outlined the various causes at work tending to the diminution or extermination of native plants in Britain—the building over of suburban and rural districts, drainage of marshes and bogs, smoke pollution, excessive collecting of rare plants by botanists and their agents, the wholesale digging up of both rare and common species by hawkers, &c. A brisk discussion followed regarding the proposed remedial measures for the preservation of the British flora; and though this was marked by considerable divergences of opinion, it was generally agreed that on one hand much remained to be done in the way of arousing public interest in the matter, while on the other there was much to be said for the introduction of legislation which should secure at least the same degree of protection and scheduling of plants as that afforded to bird-life by the Wild Birds Protection Acts. Several speakers pointed out that much might be done with the powers now possessed by local authorities but rarely exercised by them, and that in many cases small areas might be secured as nature reserves by public-spirited persons interested in the local flora before such areas were destroyed as plant habitats.

Dr. J. Mitchell Bruce will deliver the Harveian oration at the Royal College of Physicians of London on Saturday, October 18.

Under the auspices of the National Association for the Feeble-Minded, a conference of public authorities upon the subject dealt with by the association will be held at the Guildhall, London, on October 23.

The first Italian congress of radiology will be held at Milan on October 12–13. In connection with the congress there will be an exhibition of apparatus connected with Röntgen rays and investigations in radioactivity.

The twenty-first James Forrest lecture of the Institution of Civil Engineers will be delivered in the lecture theatre of the new building of the institution, Great George Street, Westminster, on Thursday, October 23, at 9 p.m., by Mr. Alexander Gracie, upon the subject of "Progress of Marine Construction."

The death is reported, at the early age of forty-two, of Mr. E. L. Morris, the biologist and curator in natural science in the museum of the Brooklyn Institute of Arts and Sciences. In addition to holding this office, Mr. Morris was one of the special plant experts of the U.S. Herbarium and the U.S. Department of Agriculture.

Mr. W. A. Tookey is to lecture to the Junior Institution of Engineers to-morrow—October 3—on gas-engine testing. On October 20 a paper is to be read by Mr. G. S. Cooper on modern coke-ovens. The new president of the institution, Sir Boverton Redwood, will deliver his presidential address on December 5, taking as his subject "The Future of Oil Fuel."

The Russian Government, reports *The Japan Chronicle* (September 11), has decided to establish a physical observatory at Vladivostok and experimental stations on the Pacific coast with the view of co-operating with the authorities of meteorological stations in China and Japan. Mr. S. D. Griboyedov, a prominent meteorologist, has been commissioned to investigate suitable sites for the proposed structures and to submit a report thereon.

It was announced in *The Times* of September 22 that a Malay python (*Python reticulatus*) in the Zoological Society's Garden had laid a number of eggs some days previously, which, after a considerable delay, she eventually brooded in the manner distinctive of this group of snakes. Unfortunately, there is every reason to believe that the eggs were not fertilised. A similar event took place in the Tower Menagerie so long ago as 1828, a second at the Jardin des Plantes in 1841, a third in the Society's Gardens in 1881, and a fourth in the Colombo Gardens in the autumn of 1904.

In *The Times* of September 25 it is stated, on the authority of a local correspondent, that steps are being taken, under the auspices of the Resident-General of France and of his Highness the Bey of Tunis, to establish in Tunisia a reserve in which the fast disappearing fauna of the country may find immunity from persecution. For this purpose some 4000 acres of wild mountainous country, with an adjoining marsh of 5000 acres, have been secured; and as this area already contains representatives of many of the wild animals of the country, the work of stocking the reserve will be much less heavy than would otherwise have been the case.

The first general meeting of the London Wireless Club was held on Tuesday of last week at the City of Westminster School, Mr. F. Hope Jones in the chair. Prof. Silvanus P. Thompson, F.R.S., Mr. A. A. Campbell Swinton, and Sir John Macpherson-Grant, Bart., have consented to become vice-presidents of the club. The honorary secretary is Mr. R. H. Klein, 18 Crediton Road, West Hampstead, N.W. The objects of the society were explained by the chairman to be the guarding of the interests of all experimenters in wireless telegraphy and telephony, and the organisation of desultory and for the most part useless work into co-operative scientific research. The committee was authorised to negotiate for the acquisition of suitable club-rooms, and their equipment with suitable aërial and instruments. A letter was read from Sir A. F. King, K.C.B., on behalf of the Postmaster-General, welcoming the formation of such a society, and indicating that certificates of its advisory committee would be accepted by him as qualification for the granting of licences. There will be two classes of members and full membership will be limited to persons having scientific qualifications. The subscriptions are at present 10*s.* 6*d.* for London members, and 5*s.* for members living outside a 25 miles' radius. The entrance fee is fixed at 2*s.* 6*d.*

A National Gas Congress and Exhibition will be held at Shepherd's Bush, London, during the whole of October, under the presidency of Sir Corbet Woodall. Space will be devoted in the exhibition to special exhibits related to hygienic and scientific lighting, the raw materials used in gas manufacture, the preparation and uses of residual products, the application of scientific apparatus, and to engineering in relation to gas manufacture, gas distribution, and gas measurement. A comprehensive series of conferences and popular lectures has been arranged. Among the subjects of the conferences are smoke abatement, to discuss the use of gas for fuel in relation to the problem of the smoke nuisance; food and cookery, to consider means for increasing knowledge of economical and correct methods of preparing and cooking food; the hygienic aspect of gas for lighting, heating, cooking, and ventilation; the lighting, heating, and ventilation of schools; the physiological and mental disadvantages of unscientific illumination; the teaching of cooking in schools; the economic value of adequate illumination; the use of gas as a fuel for industrial purposes; the use of gas for power; and the principles of scientific illumination in their relation to the use of gas for lighting.

MANY ways have already been suggested and demonstrated for causing each eye to see its appropriate picture of a stereoscopic pair, but we learn from *The Times* of September 26 that Messrs. Friedmann and Reiffenstein are showing yet another at the Austro-German Medical Congress now being held in Vienna. The new method depends upon the fact that a white image is invisible on a white background, and a black image is invisible on a black background, while both are visible if the backgrounds are reversed. The authors therefore bleach the negative of one of the pair, make an ordinary transparency from the other, and superpose the two plates. This compound plate will show either the one or the other picture according as the background put behind it is light or dark, and if the background is arranged so that it appears light to one eye and dark to the other—that is, light or dark according to the side that it is viewed from—then each eye will see its own picture without any instrumental means. A background that serves this purpose is a sheet of glass that is "ribbed convexly," while its back surface is "prepared in a special manner" that is not described. The great advantage of such stereoscopic pictures is that they only need looking at as if they were single pictures to show the full stereoscopic effect. It is stated that the few specimens shown are very satisfactory.

THE provisional programme of the Royal Geographical Society for the coming session has just been issued. We learn from it that the following papers have been arranged:—"The Work and Adventures of the Northern Party of Capt. Scott's Antarctic Expedition," R. E. Priestley (November 10); "Explorations in the Eastern Karakoram," Mrs. Bullock Workman and Dr. Hunter Workman (November 24); "Is the Earth Drying up?" Prof. J. W. Gregory, F.R.S. (December 8); "An Expedition to Dutch New Guinea," A. F. R. Wollaston (December 16). In addition to the foregoing, the following papers may be expected:—"Famous Maps in the British Museum," J. A. J. de Villiers; "Journey through Arabia," Capt. G. E. Leachman; "Geographical Aspects of Two Sub-Expeditions in the Antarctic," Griffith Taylor; "The Federal District and Capital, Camberra, of the Commonwealth of Australia," Griffith Taylor; "Journeys in the Upper Amazon Basin," Dr. Hamilton Rice; "The Gulf Stream," Commander Campbell Hepworth, C.B.; "The Red Sea and the Jordan," Sir William Willcocks, K.C.M.G.; "Fresh Discoveries in the Eket District, Southern Nigeria," P. A. Talbot; "The Panama Canal," Dr. Vaughan Cornish; "The Atlantic Ocean," Prof. E. Hull, F.R.S.; "The Anglo-German Boundary Survey in West Africa," Capt. W. V. Nugent.

IN *L'Anthropologie*, vol. xxiv., Nos. 2 and 3, Prof. G. H. Luquet proposes an explanation of the rock markings at Gavr'inis. Comparing the figures with those on the megalithic monuments in Brittany and Ireland, he suggests that they are ultimately based on an anthropomorphic attempt to represent the human figure, particularly of the eyes and eyebrows. This contribution is lavishly illustrated by woodcuts, and the explanation now offered well deserves respectful study by archæologists in this country.

MR. ANANDA COOMARASWAMY'S useful periodical, *Visvakarma*, devoted to the reproduction of examples of Indian architecture, sculpture, painting, and handicrafts, has reached its fifth number. We have a fine series of photographs, among which the most noticeable are the splendid lion column from Sarnath, the Trimurti or sacred triad from the Caves of Elephanta, and interesting figures of deer, monkeys, a cat and mice from Mamallapuram. The Asokan statue from Besnagar is one of the most remarkable sculptural remains of the period.

THE *National Geographic Magazine* for September is devoted to Egypt, and contains a large collection of beautiful photographs. Perhaps the most interesting contribution is the account by Mr. C. M. Cobern of the sacred ibis cemetery and jackal catacombs at Abydos. The ibises are as carefully mummified as the royal personages at Deir-el-Bahari, and were it not for the ravages by white ants, hundreds of these sacred birds could now be examined in as perfect a state as when they were buried. The jackals were preserved because they were sacred to Anubis, the friend of the righteous dead, who guided the soul across the trackless desert to the fields of Aalu, the land of the dead.

THE excavation of the Roman city of Corstopitum, the modern Corbridge, begun by the Northumberland County History Committee and the Corbridge Excavation Committee in 1906, was actively prosecuted during the past season. Among the objects unearthed were forty-eight gold coins and a gold ring, probably deposited about A.D. 385, several altars, a vast quantity of pottery, a bronze pig containing 160 gold coins ranging from Nero to Marcus Aurelius, the well-known Corbridge lion, a smithy with arrow-heads and other articles of iron. Thus a vast amount of material for the study of Roman pottery has been found, and the buildings include some of the most imposing relics in Roman Britain, as well as some of the worst walls ever erected by human hands. The animal remains are of high scientific value, and some addition has been made to our knowledge of Roman metallurgy. The museum has been rearranged, and now contains a collection of Roman remains unequalled in the north of England, except, perhaps, at York.

WE have to acknowledge the receipt from Messrs. Dulau and Co., Ltd., of a copy of a catalogue of works and papers on various groups of the lower invertebrates.

IN the report of the museums of the Brooklyn Institute for 1912, reference is made to the large increase in the zoological collections, and the mounting of a group of marsh-hawks for the series illustrating the fauna of Long Island. Of the fauna and flora of that island a popular account is in course of publication in vol. ii. of the Science Bulletin of the Institute, the first portion of this dealing with the bats, and the second with two species of molluscs.

In the September number of *The American Naturalist*, Prof. H. H. Newman, of Chicago University, discusses at length the remarkable phenomenon of polyembryonic development exhibited by *Dasypus novemcinctus* and certain other species of armadillos, and its bearing on sex-determination. The females of these species, when pregnant, invariably develop four embryos, enclosed in a single chorionic envelope, which are always of the same sex, the process of development being summarised by the author as follows:—"The ovogenesis is normal; a single egg is fertilised by a single spermatozoon; the cleavage is apparently normal, and gives rise to a blastodermic vesicle similar to that of other mammals, especially the rodents; germ-layer-inversion affords an easy mechanism for producing several embryos in a single chorion, for the quadruplets arise by means of dichotomous budding of the inner ectodermic vesicle without affecting the enveloping membranes of the vesicle, which form the common chorion; the subsequent embryonic development of the several embryos is as independent as it can be under monochorial conditions, since each individual has its own separate amnion, allantois, umbilicus, and placenta."

M. Fujioka contributes an elaborate study of the structure of the wood in the Japanese conifers to the Journal of the College of Agriculture, University of Tokyo, vol. iv., No. 4. The detailed descriptions of the wood in the various species examined are followed by a key to the Japanese genera of Coniferæ based upon the history of their wood, and the memoir is illustrated by seven plates containing eighty-four very fine photomicrographs.

We have received a copy of the Proceedings and Transactions of the Croydon Natural History and Scientific Society, 1912–13, which contains various items of interest. Among these there is an account of the organisation of the Regional Survey of Croydon, which the society have undertaken, and which, when completed, will form one of the most elaborate records of the natural history of a limited area that has been made. The volume also includes reports of addresses given by Dr. H. F. Parsons and Mr. A. G. Tansley, dealing respectively with "Plant Growth and Soil Conditions" and with "Practical Study of Vegetation in the Field." There is an extensive appendix containing the records of the Meteorological Committee, and giving the daily rainfall throughout the year 1912 at various stations in the district.

Miss M. C. Knowles, in a paper on the maritime and marine lichens of Howth (Sci. Proc. Royal Dublin Soc., August, 1913), gives an interesting account of the lichen vegetation of Howth Head, Dublin Bay, illustrated by several beautiful photographs by Mr. R. Welch. More than half of the memoir is occupied by a detailed description of the ecology of the lichens which inhabit the siliceous rocks on the coast and form more or less sharply defined belts or zones dominated, from above downwards, by species of Ramalina, orange-coloured lichens, species of Lichina, *Verrucaria maura*, and marine Verrucarias. Three new species are described, and notes are given on some remarkable forms of Ramalina, while the memoir as a whole may be regarded as the most important contribution that has yet been made to the ecology of the littoral lichen vegetation of this country.

We have received a Spanish edition of the "International Codex of Resolutions adopted at Congresses, Conferences, and at Meetings of the Permanent Committee, 1872–1910," translated by the Central Observatory of Manila from the second German edition. The preparation of this useful work was recommended by the International Meteorological Committee at the meeting at Southport in 1903, and Drs. Hellmann and Hildebrandsson were requested to undertake it. At the conference at Innsbruck, in 1905, a manuscript copy of the Codex was presented, and its publication in English, French, and German was urged as "a most valuable means for promoting international meteorological work." In view of the extended use of Spanish in central and southern America, and also in eastern Asia, Señor J. Algué was thanked for his offer to arrange for its publication in that language. It should be mentioned that due reference was made by Dr. Hellmann to a somewhat similar work published by Dr. Wild (then president of the International Meteorological Committee) in the *Repertorium für Meteorologie*, vol. xvi., which contained particulars for 1872–1891, and was at the time of considerable value.

In a well-known experiment of De la Rive's, one end of an electromagnet projects into an evacuated bulb containing two electrodes, one of which takes the form of a ring. When a discharge is passed the luminous column is seen to rotate round the magnet pole. This experiment receives various interesting extensions in a paper by Prof. Righi on "Rotazioni Ionomagnetiche (R. Accad. di Bologna, February, 1913). In a typical experiment the two electrodes, which are here cylindrical, are placed in the same vertical line, and the lower one is surrounded by a suspended metal cylinder. An external magnet produces a field parallel to the line joining the electrodes. When the discharge passes it is found that the cylinder rotates. The theory shows that the effect is due to the oblique impact, on the cylindrical walls, of the ions carrying the discharge.

We have received a copy of Dr. P. W. Bridgman's paper on the thermodynamic properties of twelve liquids between 20° C. and 80° C. and up to 12,000 kilograms per sq. cm. The work was carried out at the Jefferson Physical Laboratory of Harvard University by the aid of the Rumford Fund. The liquids used were methyl, ethyl, propyl, isobutyl, and amyl alcohols, ethyl ether, acetone, carbon bisulphide, phosphorus trichloride, and ethyl bromide, all of which were obtained in an approximately pure state. The liquid was contained in a cylinder closed by a piston, the motion of which determined the change of volume. The pressure applied was measured by the change of electrical resistance of a standardised manganine wire.

The whole was enclosed in a bath the temperature of which could be varied between the limits stated above. Dr. Bridgman finds that the compressibility and thermal expansion of a liquid may decrease with increasing temperature and may increase with increase of pressure. He is disposed to attribute these remarkable results to deformation of the actual molecules when forced into contact at these high pressures.

PROBABLY no branch of the community is more open to be defrauded than those who must perforce exclude carbohydrates from their diet. The unsuspecting patient purchases foods which are not only glaringly misrepresented, but also may be positively harmful to him. It is to be feared, moreover, that the medical adviser is often but little better informed, though in default of a source of trustworthy information as to the nature of the commercial products he can scarcely be held responsible. The Connecticut Agricultural Experiment Station has done great service, therefore, in issuing a lengthy report dealing with the composition and merits of all the so-called diabetic flours, breads, biscuits, and other diabetic foods of both European and American origin—the list is an exhaustive one. To all but the few initiated the result of the inquiry must be very startling. By far the greater number of the foods examined were definitely fraudulent in that they did not fulfil the claims made for them, and many of them indeed contained as much starch as is present in ordinary white bread. The report also deals with the excessive cost of such foods, which has, in the past, rendered their use almost prohibitive to the poor man. A select list of genuine diabetic foods, which return good value, is given, in which it is satisfactory to find the products of British firms of repute. Our chief purpose in directing attention to the report is, however, to urge the necessity of some control being exercised over the indiscriminate misrepresentation of foodstuffs of which this is a type with its attendant menace to the public health. The report merits the widest possible publication.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR OCTOBER :—

Oct. 2. 3h. 0m. Mars at quadrature to the Sun.
,, 14h. 0m. Jupiter at quadrature to the Sun.
6. 6h. 21m. Jupiter in conjunction with the Moon (Jupiter 4° 51′ N.).
8. 3h. 37m. Uranus in conjunction with the Moon (Uranus 3° 35′ N.).
13. 14h. 0m. Uranus stationary.
14. 9h. 0m. Venus nearest the Sun.
19. 9h. 19m. Saturn in conjunction with the Moon (Saturn 6° 56′ S.).
21. 13h. 7m. Mars in conjunction with the Moon (Mars 3° 55′ S.).
,, 18h. 0m. Neptune at quadrature to the Sun.
22. 7h. 54m. Neptune in conjunction with the Moon (Neptune 4° 53′ S.).
27. 5h. 0m. Uranus at quadrature to the Sun.
,, 8h. 31m. Venus in conjunction with the Moon (Venus 3° 17′ N.).
30. 20h. 17m. Mercury in conjunction with the Moon (Mercury 2° 2′ N.).
31. 13h. 0m. Neptune stationary.

COMETS 1913*b* (METCALF) AND 1913*c* (NEUJMIN).—Prof. H. Kobold's ephemeris for comet Metcalf during the present week is as follows (*Astronomische Nachrichten*, No. 4682):—

M.T. Berlin.

	R.A. (true) h. m. s.		Dec. (true) ° ′		Mag.
Oct. 2 ...	23 18 26	...	+72 6·0	...	8·2
3 ...	22 54 25	...	69 52·2		
4 ...	22 34 49	...	67 23·4		
5 ...	22 18 45	...	64 42·1	...	8·0
6 ...	22 5 26	...	61 51·4		
7 ...	21 54 26	...	58 53·3		
8 ...	21 45 16	...	55 50·0		
9 ...	21 37 9	...	+52 43·7	...	8·0

This comet is now in Cepheus and rapidly reducing its northern declination, moving towards the constellation of Cygnus. It is well up above the horizon and gaining in magnitude.

On the other hand, comet Neujmin is decreasing in magnitude, becoming fainter than magnitude 12. This comet seems to be moving in an elliptical orbit, and Prof. Cohn finds a period of nine years. Its appearance has attracted the attention of numerous observers, since while the nucleus has appeared quite stellar, the gaseous envelope has been alternating between visibility and disappearance.

ANOTHER COMET.—A Kiel telegram, dated September 27, distributes the information communicated by Prof. Hussey that Mr. Delaren on September 26, 10h. 29·2m. M.T. Laplata, discovered a comet of the tenth magnitude, its position being given as R.A. 21h. 54m. 16s. and declination 2° 34′ 27″ S. In the issue of *The Times* for September 30 it is suggested that probably this comet may be identical with Westphal's comet, which is now due, and for which a search has been continually made. If it be Westphal's, then it will move northward during the next month and will increase considerably in brightness, possibly becoming visible to the naked eye. At its appearance in 1852 it was a fairly conspicuous naked eye object.

THE SPECTRUM OF α-CANUM VENATICORUM.—In two previous notes in this column (June 5 and July 24) reference has been made to Prof. Belopolsky's observations of the spectrum of this star, the lines in the spectrum showing striking variations of a periodic nature. The *Astronomische Nachrichten*, No. 4681, contains now the preliminary discussion of a large number of spectrograms, sixty-seven in number, which he has been able to secure in the interval between April 15 and June 23. All the photographs were taken with the 30-inch and a three-prism spectrograph, the exposures lasting one hour; an iron comparison was photographed twice at each exposure. In the present communication Prof. Belopolsky first describes in detail the appearance of the lines observed. From the measures of the intensity of the line λ4131·00 he finds a period of 5·50 days, and he places several other lines in the same category, *i.e.* they become bright at the same time as λ4131·00. Another group of lines behaves in an opposite manner, disappearing when the former group become more intense; the period is also very near 5·50 days. Other lines such as hydrogen, magnesium, calcium, and iron display little if any change. From the line of sight measures he finds a certain group of lines, which includes H., Mg., and Fe., which indicate no changes dependent on the 5·5 day period, while other lines display variations of radial velocity equal in period to that of the intensity of the lines. Prof. Belopolsky suggests as an explanation of the above and other observations that a gaseous satellite or a gas ring moves round a central body, but he finds that there are several details that are difficult to explain which will perhaps be cleared up when more material has been collected.

THE WAVE-LENGTHS OF CERTAIN IRON LINES.—It is important for the accurate determination of wave-lengths in a spectrum to have available a large number of standard wave-lengths well distributed over the whole length of the spectrum. The work which the Solar Union initiated in this respect has been most valuable, and the task of determining more constants and of securing greater accuracy is no light one. By the aid of a grant of the Martin Kellogg fellowship in the Lick Observatory and of the generosity of MM. Buisson and Fabry, who placed the necessary apparatus and also constant help and advice at his service, Mr. Keivin Burns has been able to make a series of interference measures of standards in the iron spectrum between the limits λλ5434A and 8824A. The results of this research are recorded in Lick Bulletin, No. 233, and, in addition to the international standards already determined between the above-mentioned limits, he has added another one hundred and nineteen lines in regions which were lacking in international standard lines. Small discrepancies in different measures of some standard lines have led to the consideration of their variability of wave-length. Mr. Burns has had access to the manuscript of Dr. Goos, in which a special study has been made of the source of this variability, and he agrees entirely with the view, namely, that "Dr. Goos insists on the necessity of determining exactly what conditions the arc is to used." In this journal for September 11 last, further details will be found regarding the specified conditions for the determinations of further standards which were recommended by the committee of the Solar Union on standard wave-lengths at the recent meeting in Bonn.

THE ANTIQUITY OF MAN IN SOUTH AMERICA.[1]

THE problem of the antiquity of man in South America has given rise to many papers and much discussion in various languages, and it became necessary for a trained anthropologist and geologist to study on the spot the human remains and the exact mode of their occurrence. Dr. A. Hrdlička was undoubtedly the anthropologist best fitted for the investigation, as he has an unequalled knowledge of the physical anthropology of the American Indian and had already summarised his own investigations on the antiquity of man in North America in Bulletin 33 of the Bureau of American Ethnology (1907), where he states his conclusion that "no human bones of undisputed geological antiquity are known," and that the remains exhibit a "close affinity to or identity with those of the modern Indian."

Mr. Bailey Willis, of the U.S. Geological Survey, who had done important work on the loess and related formations in North America and China, accompanied Dr. Hrdlička to Argentina in May, 1910. The Argentine men of science received them very cordially, and facilitated their work. Most of the specimens they were to examine had been described by Prof. F. Ameghino, to whose energy and enthusiasm South American palæontology owes so much, and it must have saddened his last hours to know—if indeed he admitted it—that zeal is a poor substitute for knowledge when the details of human anatomy are in question.

[1] "Early Man in South America." By Ales Hrdlička, in collaboration with W. H. Holmes, Bailey Willis, Fred E. Wright, and Clarence N. Fenner. Pp. xv+405+68. (Smithsonian Institution, Bureau of American Ethnology, Bulletin 52. Washington, 1912.)

Mr. Bailey Willis gives an excellent account of the geology of central eastern Argentina, more especially of the Pampean terrane, which is a remarkably uniform deposit of fine-grained earth, probably an eolian formation of desert plateau origin, transported by rivers to the lowlands, but during arid episodes the alluvium was partially converted into eolian loess. There is no evidence at present that man lived during Pampean times, but his remains have been found in the Upper Pampean and Post Pampean, also mainly eolian loess formations, which lie in hollows sculptured in the surface of the Pampean, also in many cases there is a distinct unconformity beneath the deposits of the Upper Pampean. A great deal has been written about the *tierra cocida*, or burnt earth which occurs in the Pampean terrane at various horizons; many of these may have been due to the burning of grasses, but there is nothing to connect the burnt earths of the Pampean with man.

Messrs. F. E. Wright and C. N. Fenner present details of their petrographic studies of specimens of the loess, tierra cocida, and scoriæ. They state that many specimens of tierra cocida are so large and compact that one is forced to assume long-continued and confined heating at a fairly high temperature, such as would be encountered near the contact of an intrusive igneous or volcanic mass, but not beneath an open fire made of grass or small timber.

Dr. Hrdlička discusses the peculiar stone industries of the Argentine coast. Ameghino considered that the "split-stone" industry "is in certain respects more primitive than that of the eoliths of Europe," referring it to the Middle Pliocene, and that it was preceded by a "broken-stone" industry. Dr. F. F. Outes denied the distinctiveness and great antiquity of these techniques, and Hrdlička confirms him. Dr. W. H. Holmes supplies a valuable critical study of the stone implements collected by the expedition, which should be read by European archæologists, as it contains information of general interest.

The greater part of the book consists of a discussion by Dr. Hrdlička of the human remains; his system is to note the history and earlier reports, then to give the result of his own examination, and to conclude with critical remarks. He first deals with the dolichocephalic skulls found in the caves at Lagoa Santa, Brazil, and states that there is no evidence that they belonged to a race which lived contemporaneously with the extinct species of animals found in the same caves. Similarly the Carcaraña, Rio Negro, Saladero, Fontezuelas, and other remains have no solid claims to geological antiquity. The *Homo caputinclinatus* and *H. sinemento* of Ameghino prove to be skulls of ordinary Indian type, with no title to antiquity; the same holds good for *H.* (*Prothomo*) *pampaeus*, despite Ameghino's statement that it is the "earliest human representative—if not even a predecessor of man." Concerning the fragmentary calvarium, *Diprothomo platensis*, of reputed Lower Pliocene origin, Hrdlička supports Schwalbe's statement that "all the features dwelt upon by Ameghino are referable to a *wholly false orientation* of the specimen." Bailey Willis cannot give his support to the statement that the calvarium was really dug out of undisturbed ancient Pampean. Finally, the atlas and femur of *Tetraprothomo argentinus*, of supposed Upper Miocene age, have been subjected to a searching analysis by Hrdlička, with the result that there is nothing to distinguish the former from the atlas of a modern Indian, and the femur is that of a carnivore, probably of an extinct form of one of the Felidæ. Bailey Willis "does not consider the age of the so-called Monte Hermoso formation [in which the remains were found] definitely established," nor does he "attach any significance to the occurrence of burnt earth as an evidence of man's existence in the Miocene (?) 'Monte Hermosean.'" "The conclusions of the writers with regard to the evidence thus far furnished are that it fails to establish the claim that in South America there have been brought forth thus far tangible traces of either geologically ancient man himself or of any precursors of the human race." A. C. Haddon.

PAPERS ON INVERTEBRATES.

Unusual interest attaches to the description by Dr. A. Brinkmann, in the *Bergens Museum Aarbok* for 1912, part 3, of a new genus and species of deep-sea nemertine worm—*Bathynectes murrayii*—which differs from all previously known forms in the external position of the male genitalia. A single example was obtained so long ago as 1895, while sixteen others were collected by the *Michael Sars* in 1910. The length of females ranges from 43 to 61 mm., with a breadth of from 7·5 to 10 mm., but males are considerably smaller. Although the new organism, of which figures are given, represents an entirely new type, it forms in some degree a connecting link between Planktonemertes and Nectonemertes.

In connection with the above may be noticed a paper by Dr. M. v. Gedroyć, in *Bull. Ac. Sci. Cracovie* for February, 1913, on certain new European leeches, referred to the genera Trocheta and Hæmentaria, special interest from a distributional point of view attaching to the second determination, owing to the fact that while the genus was originally described from South America, it is now known to occur in the United States, Canada, Lapland, and Poland.

The death-feigning instinct (*Katalepsie*) among stick-insects (Phasmidæ), as exemplified by the species *Cerausius morosus,* forms the subject of a very interesting article by Mr. Peter Schmidt in *Biol. Centralblatt* of April 20. These insects, it appears, are extremely prone to assume the cataleptic phase, and may do so in almost any pose—sometimes lying flat on one side, with the limbs and antennæ stretched out parallel with the body, sometimes with the legs straddled outwards and the head and thorax raised, and at other times standing on the head. As these insects are specially modified to imitate vegetation, it seems that the cataleptic condition is another adaptation—of the muscular and nervous structures—to the same end.

The beetles, spiders and scorpions, earwigs, and flies collected during the Abor Expedition of 1911–12 form the subject of four articles by specialists in part 2 of vol viii. of Records of the Indian Museum, a number of new forms being described. In vol. iii., part 4, of Annals of the Transvaal Museum, Mr. L. B. Prout and Mr. E. A. Meyrick respectively describe new local Geometridæ and Micro-Lepidoptera.

We have received a copy of a concise "Synopsis of the Classification of Insects," drawn up by Prof. Maxwell Lefroy, and published by Messrs. Lumley, of Exhibition Road, at the price of one shilling. The arrangement of the orders is the one adopted by Messrs. Sharp and Shipley, and a brief, but apparently sufficient, definition is given of each order and family. The lack of an index is a decided drawback to the value of the work.

To the May number of *The Entomologist's Monthly Magazine* the Hon. Charles Rothschild contributes a note on the extremely rare bugs of the genus Cacodemus, which are parasitic on Old World bats. Three species are mentioned, one from South Africa, a second from India, and a third of which the home is at present unknown. Mr. Rothschild, it may be added, employs the name Clinocoridæ for the bugs, whereas Prof. Lefroy, in the synopsis just mentioned, uses Cimicidæ. R. L.

THE BRITISH ASSOCIATION AT BIRMINGHAM.

SECTION D.

ZOOLOGY.

Opening Address by H. F. Gadow, F.R.S., President of the Section.

"Address your audience about what you yourself happen to be most interested in, speak from the fullness of your heart, and make a clean breast of your troubles." That seemed good advice, and I shall endeavour to follow it, taking for my text old and new aims and methods of morphology, with special reference to resemblances in function and structure on the part of organs and their owners in the animal kingdom. First, however, allow me to tell you what has brought me to such a well-worn theme. Amongst the many impressions which it has been my good luck to gather during my travels in that enchanting country Mexico are the two following:—

First, the poisonous coral snakes, Elaps, in their beautiful black, red, and yellow garb; it varies in detail in the various species of Elaps, and this garb, with most of the variations too, occurs also in an astonishing number of genera and families of semi-poisonous and quite harmless Mexican snakes, some of which inhabit the same districts. A somewhat exhaustive study of these beauties has shown incontestably that these often astoundingly close resemblances are not cases of mimicry, but due to some other cooperations.

Secondly, in the wilds of the State of Michoacan, at two places, about twenty and seventy miles from the Pacific coast, I myself collected specimens of Typhlops which Dr. Boulenger without hesitation has determined as *Typhlops braminus*. Now, whilst this genus of wormlike, blind little snakes has a wide circum-tropical distribution, *T. braminus* had hitherto been known only from the islands and countries of the Indian Ocean basin, never from America, nor from any of the Pacific Islands which possess other kinds of Typhlops. Accidental introduction is out of the question. Although the genus is, to judge from its characters, an especially old one, we cannot possibly assume that the species *braminus*, if the little thing had made its way from Asia to Mexico by a natural mode of spreading, has remained unaltered even to the slightest detail since that geological epoch during which such a journey could have taken place. There remains the assumption that amongst the of course countless generations of Typhlops in Mexico some have hit off exactly the same kind of permutation and combination of those characters which we have hitherto considered as specific of *braminus,* just as a pack of cards may in a long series of deals be dealt out more than once in the same sequence.

The two cases are impressive. They reminded me vividly that many examples of very discontinuous distribution—which anyone who has worked at zoogeography will call to mind—are exhibited by genera, families, and even orders, without our knowing whether the groups in which we class them are natural or artificial. The ultimate appeal lies with anatomy.

Introduced to zoology when Haeckel and Gegenbaur were both at their zenith, I have been long enough a worker and teacher to feel elated by its progress and depressed by its shortcomings and failures. Perhaps we have gone too fast, carried along by methods which have yielded so much and therefore have made us expect too much from them.

Gegenbaur founded the modern comparative anatomy by basing it upon the theory of descent. The leading idea in all his great works is to show that transformation, "continuous adjustment"

(Spencer), has taken place; he stated the problem of comparative anatomy as the reduction of the differences in the organisation of the various animals to a common condition; and as homologous organs he defined those which are of such a common, single origin. His first work in this new line is his classical treatise on the Carpus and Tarsus (1864).

It followed from this point of view that the degree of resemblance in structure between homologous organs and the number of such kindred organs present is a measure for the affinity of their owners. So was ushered in the era of pedigree of organs, of functions, of the animals themselves. The tracing of the divergence of homogenous parts became all-important, whilst those organs or features which revealed themselves as of different origin, and therefore as analogous only, were discarded as misleading in the all-important search for pedigrees. Functional correspondence was dismissed as "mere analogy," and even the systematist has learnt to scorn these so-called physiological or adaptive characters as good enough only for artificial keys. A curious view of things, just as if it was not one and the same process which has produced and abolished both sets of characters, the so-called fundamental or "reliable," as well as the analogous.

As A. Willey has put it happily, there was more rejoicing over the discovery of the homology of some unimportant little organ than over the finding of the most appalling unrelated resemblance. Morphology had become somewhat intolerant in the application of its canons, especially since it was aided by the phenomenal growth of embryology. You must not compare ectodermal with endodermal products. You must not make a likeness out of another germinal layer or anything that appertains to it, because if you do that would be a horror, a heresy, a homoplasy.

Haeckel went so far as to distinguish between a true homology, or homophyly, which depends upon the same origin, and a false homology, which applies to all those organic resemblances which derive from an equivalent adaptation to similar developmental conditions. And he stated that the whole art of the morphologist consists in the successful distinction between these two categories. If we were able to draw this distinction in every case, possibly some day the grand tree of each great phylum, maybe of the whole kingdom, might be reconstructed. That would indeed be a tree of knowledge, and, paradoxically enough, it would be the deathblow to classification, since in this, the one and only true natural system, every degree of consanguinity and relationship throughout all animated nature, past and present, would be accounted for; and to that system no classification would be applicable, since each horizon would require its own grouping. There could be definable neither classes, orders, families, nor species, since each of these conceptions would be boundless in an upward or downward direction.

Never mind the ensuing chaos; we should at least have the pedigree of all our fellow-creatures, and of ourselves among them. Not absolute proof, but the nearest possible demonstration that transformation has taken place. Empirically we know this already, since, wherever sufficient material has been studied, be it organs, species, or larger groups, we find first that these units had ancestors, and, secondly, that the ancestors were at least a little different. Evolution is a fact of experience, proved by circumstantial evidence. Nevertheless we are not satisfied with the conviction that life is subject to an unceasing change, not even with the knowledge of the particular adjustments. We now want to understand the motive cause. First, What, then How, and now Why?

It is the active search for an answer to this question (Why?) which is characteristic of our time. More and more the organisms and their organs are considered as living, functional things. The mainspring of our science, perhaps of all science, is not its utility, not the desire to do good, but, as an eminently matter-of-fact man, the father of Frederick the Great, told his Royal Academicians (who, of course, were asking for monetary help) in the following shockingly homely words: "Der Grund ist derer Leute ihre verfluchte Curieusiteit." This blamed curiosity, the beginnings of which can be traced very far back in the lower animals, is most acutely centred in our desire to find out who we are, whence we have come, and whither we shall go. And even if zoology, considering the first and last of these three questions as settled, should some day solve the problem: Whence have we come? there would remain outside zoology the greater Why?

Generalisations, conclusions, can be arrived at only through comparison. Comparison leads no further where the objects are alike. If, for instance, we restrict ourselves to the search for true homologies, dealing with homogenes only, all we find is that once upon a time some organism has produced, invented, a certain arrangement or *Anlage* out of which that organ arose, the various features of which we have compared in the descendants. Result: we have arrived at an accomplished fact. These things, in spite of all their variety in structure and function, being homogenes, tell us nothing, because according to our mode of procedure we cannot compare that monophyletic *Anlage* with anything else, since we have reduced all the homogenous modifications to one. Logically it is true that there can have been only one, but in the living world of nature there are no such iron-bound categories and absolute distinctions. For instance, if we compare the organs of one and the same individual, we at once observe repetition, *e.g.* that of serial homology, which implies many difficulties, with very different interpretations. Even in such an apparently simple case as the relation between shoulder girdle and pelvis we are at a loss, since the decision depends upon our view as to the origin of the paired limbs, whether both are modified visceral arches, and in this case serially repeated homogenes, or whether they are the derivatives from one lateral fin, which is itself a serial compound, from which, however, the proximal elements, the girdles, are supposed to have arisen independently. What is metamerism? Is it the outcome of a process of successive repetitions so that the units are homogenes, or did the division take place at one time all along the line, or is it due to a combination of the two procedures?

The same vagueness finds its parallel when dealing with the corresponding organs of different animals, since these afford the absolute chance that organs of the same structure and function may not be reducible to one germ, but may be shown to have arisen independently in time as well as with reference to the space they occupy in their owners. As heterogenes they can be compared as to their causes. In the study of the evolution of homogenes the problem is to account for their divergencies, whilst the likeness, the agreements, so to speak their greatest common measure, is *eo ipso* taken to be due to inheritance. When, on the contrary, dealing with heterogenes, we are attracted by their resemblances, which since they cannot be due to inheritance must have a common cause outside themselves. Now, since a leading feature of the evolution of homogenes is divergence, whilst that of heterogenes implies convergence from different starting points, it follows that the more distant are these respective starting points (either in time or in the material) the better is our chance of extracting the greatest common measure out of the unknown number of causes which combine in the production of even the apparently simplest organ.

These resemblances are a very promising field, and the balance of importance will more and more incline towards the investigation of function, a study which, however, does not mean mere physiology with its present-day aims in the now tacitly accepted sense, but that broad study of life and death which is to yield the answer to the question Why?

Meantime, comparative anatomy will not be shelved; it will always retain the casting-vote as to the degree of affinity among resemblances, but emphatically its whole work is not to be restricted to this occupation. It will increasingly have to reckon with the functions, indeed never without them. The animal refuses to yield its secrets unless it be considered as a living individual. It is true that Gegenbaur himself was most emphatic in asserting that an organ is the result of its function. Often he held up to scorn the embryographer's method of muddling cause and effect, or he mercilessly showed that in the reconstruction of the evolution of an organ certain features cannot have been phases unless they imply physiological continuity. And yet how moderately is function dealt with in his monumental text-book and how little is there in others, even in text-books of zoology!

> Habt alle die Theile in der Hand,
> Fehlt leider nur das geistige Band—Life!

We have become accustomed to the fact that like begets like with small differences, and from the accepted point of view of evolution *versus* creation we no longer wonder that descendants slowly change and diverge. But we are rightly impressed when unlike comes to produce like, since this phenomenon seems to indicate a tendency, a set purpose, a *beau idéal*, which line of thought or rather imperfect way of expression leads dangerously near to the crassest teleology.

But, teleology apart, we can postulate a perfect agreement in function and structure between creatures which have no community of descent. The notion that such agreement *must* be due to blood-relationship involved, among other difficulties, the dangerous conclusion that the hypothetical ancestor of a given genuine group possessed in potentiality the *Anlagen* of all the characters exhibited by one or other of the component members of the said group.

The same line of thought explained the majority of human abnormalities as atavistic, a procedure which would turn the revered ancestor of our species into a perfect museum of antiquities, stocked with tools for every possible emergency.

The more elaborate certain resemblances are, the more they seem to bear the hall-mark of near affinity of their owners. When occurring in far-related groups they are taken at least as indications of the homology of the organs. There is, for instance, a remarkable resemblance between the *bulla* of the whale's ear and that of the *Pythonomorph Plioplatycarpus*. If you homologise the mammalian tympanic with the quadrate the resemblance loses much of its perplexity, and certain Chelonians make it easier to understand how the modifications may have been brought about. But, although we can arrange the Chelonian, Pythonomorph, and Cetacean conditions in a progressive line, this need not represent the pedigree of this *bulla*. Nor is it necessarily referable to the same *Anlage*. Lastly, if, as many anatomists believe, the reptilian quadrate appears in the mammals as the *incus*, then all homology and homogeny of this *bullae* is excluded. In either case we stand before the problem of the formation of a *bulla* as such. The significant point is this, that although we dismiss the *bulla* of whale and reptile as obvious homoplasy, such resemblances, if they occur in two orders of reptiles, we take as indicative of relationship until positive evidence to the contrary is produced. That this is an unsound method is brought home to us by an ever-increasing number of cases which tend to throw suspicion on many of our reconstructions. Not a few zoologists look upon such cases as a nuisance and the underlying principle as a bugbear. So far from that being the case, such study promises much beyond the pruning of our standard trees—by relieving them of what reveal themselves as grafts instead of genuine growth—namely, the revelation of one or other of the many agencies in their growth and structure.

Since there are all sorts and conditions of resemblances, we require technical terms. Of these there is abundance, and it is with reluctance that I propose adding to them. I do so because unfortunately some terms are undefined, perhaps not definable; others have not "caught on," or they suffer from that mischievous law of priority in nomenclature.

The terms concerning morphological homologies date from Owen; Gegenbaur and Haeckel rearranged them slightly. Lankester, in 1870, introduced the terms homogenous, meaning alike born, and homoplastic, or alike moulded. Mivart rightly found fault with the detailed definition and the subdivisions of homoplasy, and very logically invented dozens of new terms, few of which, if any, have survived. It is not necessary to survey the ensuing literature. For expressing the same phenomenon we have now the choice between homoplasy, homomorphy, isomorphy, heterophyletic convergence, parallelism, &c. After various papers by Osborn, who has gone very fully into these questions, and Willey's "Parallelism," Abel, in his fascinating "Grundzüge der Palæobiologie," has striven to show by numerous examples that the resemblances or "adaptive formations" are cases of parallelism if they depend upon the same function of homologous organs, and convergences if brought about by the same function of non-homologous organs.

I suggest an elastic terminology for the various resemblances indicative of the degree of homology of the respective organs, the degree of affinity of their owners, and lastly the degree of the structural likeness attained.

Homogeny.—The structural feature is invented once and is transmitted, without a break, to the descendants, in which it remains unaltered, or it changes by mutation or divergence, neither of which changes can bring the ultimate results nearer to each other. Nor can their owners become more like each other, since the respective character made its first appearance either in one individual, or, more probably, in many of one and the same homogenous community.

Homoplasy.—The feature or character is invented more than once, and independently. This phenomenon excludes absolute identity; it implies some unlikeness due to some difference in the material, and there is further the chance of the two or more inventions, and therefore also of their owners, becoming more like each other than they were before

CATEGORIES OF HOMOPLASY.

Isotely.[1]—If the character, feature, or organ has been evolved out of homologous parts or material, as is most likely the case in closely related groups, and if the subsequent modifications proceed by similar stages and means, there is a fair probability or chance of very close resemblance. *Iso-tely*: the same mark has been hit.

Homoeotely.—Although the feature has been evolved

[1] *Cf.* "Isotely and Coralsnakes." By H. Gadow, Zoolog. Jahrbücher, Abt. f. Syst., xxxi., 1911.

from homologous parts or material, the respective modifications may proceed by different stages and means, and the ultimate resemblance will be less close and deficient in detail. Such cases are most likely to happen between groups of less close affinity, whether separated by distance or by time. *Homoeo-tely*: the same end has been fairly well attained. The target has been hit, but not the mark.

Paratelv.—The feature has been evolved from parts and material so different that there is scarcely any or no relationship. The resulting resemblance will at best be more or less superficial; sometimes a sham, although appealing to our fancy. *Para-tely*: the neighbouring target has been hit.

EXAMPLES.

Isotely: Bill of the Ardeidæ Balæniceps (Africa) and Cancroma (tropical America).

Zygodactyle foot of cuckoos, parrots, woodpeckers $\left(\frac{2\ 3}{1\ 4}\right)$.

Patterns and coloration of Elaps and other snakes.

Parachute of Petaurus (marsupial); Pteromys (rodent) and Galeopithecus.

Perissodactylism of Litopterna and Hippoids.

Bulla auris of Plioplatecarpus (Pythonomorphe) and certain whales; if tympanic = quadrate.

Grasping instruments or nippers in Arthropods: pedipalps of Phryne; chelæ of squill; first pair of mantis' legs.

General appearance of moles and Notoryctes, if both considered as mammals; of gulls and petrels, if considered as birds.

Homoeotely: Heterodactyle foot of Trogons $\left(\frac{3\ 4}{2\ 1}\right)$.

Jumping foot of Macropus, Dipus, Tarsius.

Intertarsal and cruro-tarsal joint.

Fusion and elongation of the three middle metarsals of Dipus and Rhea.

Paddles of Ichthyosaurs. Turtles, whales, penguins.

"Wings" of Pterosaurs and bats.

Long flexible bill of Apteryx and snipes.

Proteroglyph dentition of cobras and Solenoglyph dentition of vipers.

Loss of the shell of Limax and Aplysia.

Complex molar pattern of horse and cow.

Parately: Bivalve shell of Brachiopods and Lamellibranchs.

Stretcher-sesamoid bone of Pterodactyls (radial carpal); of flying squirrels (on pisiform); of Anomalurus (on olecranon).

Bulla auris of Pythonomorph (quadrate) and Wale (tympanic); if *incus* = quadrate.

"Wings" of Pterosaurs, or bats, and birds.

The distinction between these three categories must be vague because that between homology and analogy is also arbitrary, depending upon the standpoint of comparison. As lateral outgrowths of vertebræ all ribs are homogenes, but if there are at least hæmal and pleural ribs, then those organs are not homologous even within the class of fishes. If we trace a common origin far enough back we arrive near bedrock with the germinal layers. So there are specific, generic, ordinal, &c., homoplasies. The potentiality of resemblance increases with the kinship of the material.

Bateson, in his study of Homœosis, has rightly made the solemn quotation: "There is the flesh of fishes . . . birds . . . beasts, &c." Their flesh will not and cannot react in exactly the same way under otherwise precisely the same conditions, since each kind of flesh is already biased, encumbered by inheritances. If a certain resemblance between a reptile and mammal dates from Permian times, it may be homogenous, like the pentadactyle limb which as such has persisted; but if that resemblance has first appeared in the Cretaceous period it is Homoplastic, because it was brought about long after the class division. To cases within the same order we give the benefit of the doubt more readily than if the resemblance concerned members of two orders, and between the phyla we rightly seek no connection. However, so strongly is our mode of thinking influenced by the principle of descent that, if the same feature happen to crop up in more than two orders, we are biased against Homoplasy.

The readiness with which certain Homoplasies appear in related groups seems to be responsible for the confounding of the potentiality of convergent adaptation with a latent disposition, as if such cases of Homoplasy were a kind of temporarily deferred repetition, *i.e.* after all due to inheritance. This view instances certain recurring tooth patterns, which, developing in the embryonic teeth, are said not to be due to active adaptation or acquisition, but to selection of accomplished variations, because it is held inconceivable that use, food, &c., should act upon a finished tooth. It is not so very difficult to approach the solution of this apparently contradictory problem. Teeth, like feathers, can be influenced long before they are ready by the life experiences of their predecessors. A very potent factor in the evolution of Homoplasies is correlation, which is sympathy, just as inheritance is reminiscence. The introduction of a single new feature may affect the whole organism profoundly, and one serious case of Isotely may arouse unsuspected correlations and thus bring ever so many more homoplasies in its wake.

Function is always present in living matter; it is life. It is function which not only shapes, but creates the organ or suppresses it, being indeed at bottom a kind of reaction upon some stimulus, which stimuli are ultimately all fundamental, elementary forces, therefore few in number. That is a reason why nature seems to have but few resources for meeting given "requirements"—to use an everyday expression which really puts the cart before the horse. This paucity of resources shows itself in the repetition of the same organs in the most different phyla. The eye has been invented dozens of times. Light, a part of the environment, has been the first stimulus. The principle remains the same in the various eyes; where light found a suitably reacting material a particular evolution was set going, often round about, or topsy-turvy, implying amendments; still, the result was an eye. In advanced cases a scientifically constructed dark chamber with lens, screen, shutters, and other adjustments. The detail may be unimportant, since in the various eyes different contrivances are resorted to.

Provided the material is suitable, plastic, amenable to prevailing environmental or constitutional forces, it makes no difference what part of an organism is utilised to supply the requirements of function. You cannot make a silk purse out of a sow's ear, but you can make a purse, and that is the important point. The first and most obvious cause is function, which itself may arise as an incidental action due to the nature of the material. The oxydising of the blood is such a case, and respiratory organs have been made out of whatever parts invite osmotic contact of the blood with air or water. It does not matter whether respiration is carried on by ecto- or by endodermal epithelium. Thus are developed internal gills, or lungs, both of which may be considered as referable to pharyngeal pouches; but where the outer skin has become suitably osmotic, as in the naked Amphibia, it may evolve external gills. Nay, the whole surface of the body may become so osmotic that both lungs and gills are suppressed, and the creature breathes in a most pseudo-primitive fashion. This arrangement, more or less advanced, occurs in many Urodeles, both American and European, belonging to several sub-families, but not in every species of the various genera. It is therefore a case of apparently recent Isotely.

There is no prejudice in the making of a new organ except in so far that every organism is conservative, clinging to what it or its ancestors have learnt or acquired, which it therefore seeks to recapitulate. Thus in the vertebrata the customary place for respiratory organs is the pharyngeal region. Every organism, of course, has an enormous back history; it may have had to use every part in every conceivable way, and it may thereby have been trained to such an extent as to yield almost at once, like a bridle-wise horse to some new stimulus, and thus initiate an organ straight to the point.

Considering that organs put to the same use are so very often the result of analogous adaptation, homoplasts with or without affinity of descent, are we not justified in accusing morphology of having made rather too much of the organs as units, as if they were concrete instead of inducted abstract notions? An organ which changes its function may become a unit so different as to require a new definition. And two originally different organs may come to resemble each other so much in function and structure that they acquire the same definition as one new unit. To avoid this dilemma the morphologist has, of course, introduced the differential of descent, whether homologous or analogous, into his diagnoses of organs.

The same principles must apply to the classification of the animals. To group the various representative owners of cases of isotely together under one name, simply because they have lost those characters which distinguished their ancestors, would be subversive of phyletic research. It is of the utmost significance that such "convergences" (rather "mergers," to use an administrative term) do take place, but that is another question. If it could be shown that elephants in a restricted sense have been evolved independently from two stems of family rank, the convergent terminals must not be named Elephantinæ, nor can the representatives of successive stages or horizons of a monophyletic family be designated and lumped together as subfamilies. And yet something like this practice has been adopted from Cope by experienced zoologists with a complete disregard of history, which is an inalienable and important element in our science.

This procedure is no sounder than would be the sorting of our Cartwrights, Smiths, and Bakers of sorts into as many natural families. It would be subversive of classification, the aim of which is the sorting of a chaos into order. We must not upset the well-defined relative meaning of the classificatory terms which have become well established conceptions; but what such an assembly as the terminal elephants should be called is a new question, the urgency of which will soon become acute. It applies at least to assemblies of specific, generic, and family rank, for each of which grades a new term, implying the principle of convergence, will have to be invented. In some cases geographical terms may be an additional criterion. Such terms will be not only most convenient, but they will at once act as a warning not to use the component species for certain purposes. There is, for instance, the case of *Typhlops braminus*, mentioned at the beginning of this address. Another case is the dog species, called *Canis familiaris*, about which it is now the opinion of the best authorities that the American dogs of sorts are the descendants of the coyote, while some Indian dogs are descendants of a jackal, and others again are traceable to some wolf. The "dog," a definable conception, has been invented many times, and in different countries and out of different material. It is an association of converged heterogeneous units. We have but a smile for those who class whales with fishes, or the blind-worm with the snakes; not to confound the amphibian Cœcilians with reptilian Amphisbænas requires some training; but what are we to do with creatures who have lost or assimilated all those differential characters which we have got used to rely upon?

In a homogeneous crowd of people we are attracted by their little differences, taking their really important agreements for granted; in a compound crowd we at once sort the people according to their really unimportant resemblances. That is human nature.

The terms "convergence" and "parallelism" are convenient if taken with a generous pinch of salt. Some authors hold that these terms are but imperfect similes, because two originally different organs can never converge into one identical point, still less can their owners whose acquired resemblance depresses the balance of all their other characters. For instance, no lizard can become a snake, in spite of ever so many additional snake-like acquisitions, each of which finds a parallel, an analogy in the snakes. Some zoologists therefore prefer contrasting only parallelism and divergence. A few examples may illustrate the justification of the three terms. If out of ten very similar black-haired people only two become white by the usual process, whilst the others retain their colour, then these two diverge from the rest; but they do not, by the acquisition of the same new feature, become more alike each other than they were before. Only with reference to the rest do they seem to liken as they pass from black through grey to white, our mental process being biased by the more and more emphasised difference from the majority.

10 Ax Bx Cx D E F
9
8
7
6
5
4
3
2 Ax Bx
1 A B C D E F

Supposing A and B both acquire the character x and this continues through the next ten generations, while in the descendants of C the same character is invented in the tenth generation, and whilst the descendants of D, E, F still remain unaltered. Then we should be strongly inclined, not only to "key together $C\frac{x}{10}$ with $A\frac{x}{10}$ and $B\frac{x}{10}$, but take this case for one of convergence, although it is really one of parallelism. If it did not sound so contradictory it might be called parallel divergence. The inventors diverge from the majority in the same direction: Isotely.

Third case.—Ten people, contemporaries, are alike but for the black or red hair. Black A turns white and red E turns white, not through exactly identical stages, since E will pass through a reddish-grey tinge. But the result is that A and E become actually more like each other than they were before. They *converge*, although they have gone in for exactly the same divergence with reference to the majority.

In all three cases the variations begin by divergence from the majority, but we can well imagine that all the members of a homogeneous lot change ortho-genetically (this term has been translated into the far less expressive "rectigrade") in one direction, and if there be no lagging behind, they all reach precisely the same end. This would be a case of transmutation (true mutations in Waagen's and Scott's sense), producing new species without thereby increasing their number, whilst divergence always implies, at least potentially, increase of species, genera, families, &c.

If for argument's sake the mutations pass through the colours of the spectrum, and if each colour be deemed sufficient to designate a species, then, if all the tenth generations have changed from green to yellow and those of the twentieth generation from yellow to red, the final number of species would be the same. And even if some lagged behind, or remained stationary, these epistatic species (Eimer) are produced by a process which is not the same as that of divergence or variation in the usual sense.

The two primary factors of evolution are environment and heredity. Environment is absolutely inseparable from any existing organism, which therefore must react (adaptation) and at least some of these results gain enough momentum to be carried into the next generation (heredity).

The life of an organism, with all its experiments and doings, is its ontogeny, which may therefore be called the subject of evolution, but not a factor. Nor is selection a primary and necessary factor, since, being destructive, it invents nothing. It accounts, for instance, for the composition of the present fauna, but has not made its components. A subtle scholastic insinuation lurks in the plain statement that by ruthless elimination a black flock of pigeons can be produced, even that thereby the individuals have been made black. (But, of course, the breeder has thereby not invented the black pigment.)

There can be no evolution, progress, without response to stimulus, be this environmental or constitutional, *i.e.* depending upon the composition and the correlated working of the various parts within the organism. Natural selection has but to favour this plasticity, by cutting out the non-yielding material, and through inheritance the adaptive material will be brought to such a state of plasticity that it is ready to yield to the spur of the moment, and the foundation of the same new organs will thereby be laid, whenever the same necessity calls for them. Here is a dilemma. On one hand, the organism benefits from the ancestral experience; on the other, there applies to it de Rosa's law of the reduction of variability, which narrows the chances of change into fewer directions. But in these few the changes will proceed all the quicker and farther. Thus progress is assured, even hypertely, which may be rendered by "over-doing a good thing."

Progress really proceeds by mutations, spoken of before, orthogenesis, and it would take place without selection and without necessarily benefiting the organism. It would be mere presumption that the seven-gilled shark is worse off than its six- or five-gilled relations; or to imagine that the newt with double trunk-veins suffers from this arrangement, which morphologically is undoubtedly inferior to the unpaired, azygous, &c., modifications. The fact that newts exist is proof that they are efficient in their way. Such orthogenetic changes are as predictable in their results as the river which tends to shorten its course to the direct line from its head waters to the sea. That is the rivers Entelechy and no more due to purpose or design than is the series of improvements from the many gill-bearing partitions of a shark to the fewer, and more highly finished comb-shaped gills of a Teleostean fish.

The success of adaptation, as measured by the morphological grade of perfection reached by an organ, seems to depend upon the phyletic age of the animal when it was first subjected to these "temptations." The younger the group, the higher is likely to be the perfection of an organic system, organ, or detail. This is not a platitude. The perfection attained does not depend merely upon the length of time available for the evolution of an organ. A recent Teleostean has had an infinitely longer time as a fish than a reptile, and this had a longer time than a mammal, and yet the same problem is solved in a neater, we might say in a more scientifically correct, way by a mammal than by a reptile, and the reptile in turn shows an advance in every detail in comparison with an amphibian, and so forth.

A few examples will suffice:—

The claws of reptiles and those of mammals; there are none in the amphibians, although some seem to want them badly, like the African frog Gampsosteonyx, but its cat-like claws, instead of being horny sheaths, are made out of the sharpened phalangeal bones which perforate the skin.

The simple contrivance of the rhinocerotic horn, introduced in Oligocene times, compared with the antlers of Miocene Cervicornia and these with the response made by the latest of Ruminants, the hollow-horned antelopes and cattle. The heel-joint; unless still generalised, it tends to become intertarsal (attempted in some lizards, pronounced in some dinosaurs and in the birds) by fusion of the bones of the tarsus with those above and below, so that the tarsals act like epiphysial pads. Only in mammals epiphyses are universal. Tibia and fibula having their own, the pronounced joint is cruro-tarsal, and all the tarsals could be used for a very compact, yet non-rigid arrangement. The advantage of a cap, not merely the introduction of a separate pad, is well recognised in engineering.

Why is it that mammalian material can produce what is denied to the lower classes? In other words, why are there still lower and middle classes? Why have they not all by this time reached the same grade of perfection? Why not indeed, unless because every new group is less hampered by tradition, much of which must be discarded with the new departure; and some of its energy is set free to follow up this new course, straight, with ever-growing results, until in its turn this becomes an old rut out of which a new jolt leads once more into fresh fields.

SECTION E.

GEOGRAPHY.

OPENING ADDRESS BY PROF. H. N. DICKSON, PRESIDENT OF THE SECTION.

SINCE the last meeting of this Section the tragic fate of Captain Scott's party, after its successful journey to the South Pole, has become known; and our hopes of welcoming a great leader, after great achievement, have been disappointed. There is no need to repeat here the narrative of events, or to dwell upon the lessons afforded by the skill, and resource, and heroic persistence, which endured to the end. All these have been, or will be, placed upon permanent record. But it is right that we should add our word of appreciation, and proffer our sympathy to those who have suffered loss. It is for us also to take note that this last of the great Antarctic expeditions has not merely reached the Pole, as another has done, but has added, to an extent that few successful exploratory undertakings have ever been able to do, to the sum of scientific geographical knowledge. As the materials secured are worked out it will, I believe, become more and more apparent that few of the physical and biological sciences have not received contributions, and important contributions, of new facts; and also that problems concerning the distribution of the different groups of phenomena and their action and reaction upon one another—the problems which are specially within the domain of the geographer—have not merely been extended in their scope but have been helped to their solution.

The reaching of the two poles of the earth brings to a close a long and brilliant chapter in the story of geographical exploration. There is still before us a vista of arduous research in geography, bewildering almost in its extent, in such a degree indeed that "the scope of geography" is in itself a subject of perennial interest. But the days of great pioneer discoveries in topography are definitely drawn to their close. We know the size and shape of the earth, at least to a first approximation, and as the map fills up we know that there can be no new continents and no new oceans to discover, although all are still, in a sense, to conquer. Looking back, we find that the qualities of human enterprise and endurance have shown no change; we need no list of names to prove that they were alike in the days of the earliest explorations, of the discovery of the New World or of the sea route to India, of the "Principall Navigations," or of this final attainment of the Poles. The love of adventure and the gifts of courage and endurance have remained the same: the order of discovery has been determined rather by the play of imagination upon accumulated knowledge, suggesting new methods and developing appropriate inventions. Men have dared to do risky things with inadequate appliances, and in doing so have shown how the appliances may be improved and how new enterprises may become possible as well as old ones easier and safer. As we come to the end of these "great explorations," and are restricted more and more to investigations of a less striking sort, it is well to remember that in geography, as in all other sciences, research continues to make as great demands as ever upon those same qualities, and that the same recognition is due to those who continue in patient labour.

When we look into the future of geographical study, it appears that for some time to come we shall still be largely dependent upon work similar to that of the pioneer type to which I have referred, the work of perfecting the geographer's principal weapon, the map. There are many parts of the world about which we can say little except that we know they exist; even the topographical map, or the material for making it, is wanting; and of only a few regions are there really adequate distributional maps of any kind. These matters have been brought before this Section and discussed very fully in recent years, so I need say no more about them, except perhaps to express the hope and belief that the production of topographical maps of difficult regions may soon be greatly facilitated and accelerated with the help of the new art of flying.

I wish to-day rather to ask your attention for a short time to a phase of pioneer exploration which has excited an increasing amount of interest in recent years. Civilised man is, or ought to be, beginning to realise that in reducing more and more of the available surface of the earth to what he considers a habitable condition he is making so much progress, and making it so rapidly, that the problem of finding suitable accommodation for his increasing numbers must become urgent in a few generations. We are getting into the position of the merchant whose trade is constantly expanding and who foresees that his premises will shortly be too small for him. In our case removal to more commodious premises elsewhere seems impossible—we are not likely to find a means of migrating to another planet—so we are driven to consider means of rebuilding on the old site, and so making the best of what we have, that our business may not suffer.

In the type of civilisation with which we are most familiar there are two fundamental elements—supplies of food energy, and supplies of mechanical energy. Since at present, partly because of geographical conditions, these do not necessarily (or even in general) occur together, there is a third essential factor, the line of transport. It may be of interest to glance, in the cursory manner which is possible upon such occasions, at some geographical points concerning each of these factors, and to hazard some speculations as to the probable course of events in the future.

In his presidential address to the British Association at its meeting at Bristol in 1898, Sir William Crookes gave some valuable estimates of the world's supply of wheat, which, as he pointed out, is "the most sustaining food-grain of the great Caucasian race." Founding upon these estimates, he made a forecast of the relations between the probable rates of increase of supply and demand, and concluded that "Should all the wheat-growing countries add to their (producing) area to the utmost capacity, on the most careful calculation the yield would give us only an addition of some 100,000,000 acres, supplying, at the average world-yield of 12·7 bushels to the acre, 1,270,000,000 bushels, just enough to supply the increase of population among bread-eaters till the year 1931." The president then added, "Thirty years is but a day in the life of a nation. Those present who may attend the meeting of the British Association thirty years hence will judge how far my forecasts are justified."

Half the allotted span has now elapsed, and it may be useful to inquire how things are going. Fortunately this can be easily done, up to a certain point at any rate, by reference to a paper published recently by Dr. J. F. Unstead (*Geographical Journal*, August, 1913), in which comparisons are given for the decades 1881–90, 1891–1900, and 1901–10. Dr. Unstead shows that the total wheat harvest for the world may be estimated at 2258 million bushels for the first of these periods, 2575 million for the second, and 3233 million for the third, increases of 14 per cent. and 25 per cent. respectively. He points out that the increases were due "mainly to an increased acreage," the areas being 192, 211, and 242 million acres, but also "to some extent (about 8 per cent.) to an increased average yield per acre, for while in the first two periods this was 12 bushels, in the third period it rose to 13 bushels per acre."

If we take the period 1891–1900, as nearly corresponding to Sir William Crookes's initial date, we find that the succeeding period shows an increase of 658 million bushels, or about half the estimated increase required by 1931, and that attained chiefly by "increased acreage."

But signs are not wanting that increase in this way will not go on indefinitely. We note (also from Dr. Unstead's paper) that in the two later periods the percentage of total wheat produced which was exported from the United States fell from 32 to 19, the yield per acre showing an increase meanwhile to 14 bushels. In the Russian Empire the percentage fell from 26 to 23, and only in the youngest of the new countries—Canada, Australia, the Argentine—do we find large proportional increases. Again, it is significant that in the United Kingdom, which is, and always has been, the most sensitive of all wheat-producing countries to variations in the floating supply, the *rate* of falling-off of home production shows marked if irregular diminution.

Looking at it in another way, we find (still from Dr. Unstead's figures) that the total amount sent out by the great exporting countries averaged, in 1881–90, 295 million bushels, 1891–1900, 402 millions, 1901–10, 532 millions. These quantities represent respectively 13·0, 15·6, and 16·1 per cent. of the total production, and it would appear that the percentage available for export from these regions is, for the time at least, approaching its limit, *i.e.* that only about one-sixth of the wheat produced is available from surpluses in the regions of production for making good deficiencies elsewhere.

There is, on the other hand, abundant evidence that improved agriculture is beginning to raise the yield per acre over a large part of the producing area. Between the periods 1881–90 and 1901–10 the average in the United States rose from 12 to 14 bushels; in Russia from 8 to 10; in Australia from 8 to 10. It is likely that, in these last two cases at least, a part of the increase is due merely to more active occupation of fresh lands as well as to use of more suitable varieties of seed, and the effect of improvements in methods of cultivation alone is more apparent in the older countries. During the same period the average yield increased in the United Kingdom from 28 to 32 bushels, in France from 17 to 20, Holland 27 to 33, Belgium 30 to 35, and it is most marked in the German Empire, for which the figures are 19 and 29.

In another important paper (*Geographical Journal*, April and May, 1912) Dr. Unstead has shown that the production of wheat in North America may still, in all likelihood, be very largely increased by merely increasing the area under cultivation, and the reasoning by which he justifies this conclusion certainly holds good over large districts elsewhere. It is of course impossible, in the present crude state of our knowledge of our own planet, to form any accurate estimate of the area which may, by the use of suitable seeds or otherwise, become available for extensive cultivation. But I think it is clear that the available proportion of the total supply from "extensive" sources has reached, or almost reached, its maximum, and that we must depend more and more upon intensive farming, with its greater demands for labour.

The average total area under wheat is estimated by Dr. Unstead as 192 million acres for 1881–90, 211 million acres for 1891–1900, and 242 million acres for 1901–10. Making the guess, for we can make nothing better, that this area may be increased to 300 million acres, and that under ordinary agriculture the average yield may eventually be increased to 20 bushels over the whole, we get an average harvest of 6000 million bushels of wheat. The average wheat-eater consumes, according to Sir William Crookes's figures, about four and a half bushels per annum; but the amount tends to increase. It is as much (according to Dr. Unstead) as six bushels in the United Kingdom and eight bushels in France. Let us take the British figure, and it appears that on a liberal estimate the earth may in the end be able to feed permanently 1000 million wheat-eaters. If prophecies based on population statistics are trustworthy, the crisis will be upon us before the end of this century. After that we must either depend upon some substitute to reduce the consumption per head of the staple foodstuff, or we must take to intensive farming of the most strenuous sort, absorbing enormous quantities of labour and introducing, sooner or later, serious difficulties connected with plant-food. We leave the possibility of diminishing the rate of increase in the number of bread-eaters out of account for the moment.

We gather, then, that the estimates formed in 1898 are in the main correct, and the wheat problem must become one of urgency at no distant date, although actual shortage of food is a long way off. What is of more immediate significance to the geographer is the element of change, of return to earlier conditions, which is emerging even at the present time. If we admit, as I think we must do, that the days of increase of extensive farming on new land are drawing to a close, then we admit that the assignment of special areas for the production of the food-supply of other distant areas is also coming to its end. The opening up of such areas, in which a sparse population produces food in quantities largely in excess of its own needs, has been the characteristic of our time, but it must give place to a more uniform distribution of things, tending always to the condition of a moderately dense population, more uniformly distributed over large areas, capable of providing the increased labour necessary for the higher type of cultivation, and self-supporting in respect of grain-food at least. We observe in passing that the colonial system of our time only became possible on the large scale with the invention of the steam-locomotive, and that the introduction of railway systems in the appropriate regions, and the first tapping of nearly all such regions on the globe, has taken less than a century.

Concentration in special areas of settlement, formerly chiefly effected for military reasons, has in modern times been determined more and more by the distribution of supplies of energy. The position of the manufacturing district is primarily determined by the supply of coal. Other forms of energy are, no doubt, available, but, as Sir William Ramsay showed in his presidential address at the Portsmouth meeting in 1911, we must in all probability look to coal as being the chief permanent source.

In the early days of manufacturing industries the main difficulties arose from defective land transport. The first growth of the industrial system, therefore, took place where sea transport was relatively easy; raw material produced in a region near a coast was carried to a coalfield also near a coast, just as in times when military power was chiefly a matter of "natural defences," the centre of power and the food-producing colony had to be mutually accessible. Hence the Atlantic took the place of the Mediterranean, Great Britain eventually succeeded Rome, and eastern North America became the counterpart of northern Africa. It is to this, perhaps more than to anything else, that we owe our tremendous start amongst the industrial nations, and we observe that we used it to provide less favoured nations with the means of improving their system of land transport, as well as actually to manufacture imported raw material and redistribute the products.

But there is, of course, this difference between the supply of foodstuff (or even military power) and mechanical energy, that in the case of coal at least it is necessary to live entirely upon capital; the storing up of energy in new coalfields goes on so slowly in comparison with our rate of expenditure that it may be altogether neglected. Now in this country we began to use coal on a large scale a little more than a century ago. Our present yearly consumption is of the order of 300 millions of tons, and it is computed (General Report of the Royal Commission on Coal Supplies, 1906) that at the present rate of increase "the whole of our available supply will be exhausted in 170 years." With regard to the rest of the world we cannot, from lack of data, make even the broad assumptions that were possible in the case of wheat supply, and for that and other reasons it is therefore impossible even to guess at the time which must elapse before a universal dearth of coal becomes imminent; it is perhaps sufficient to observe that to the best of our knowledge and belief one of the world's largest groups of coalfields (our own) is not likely to last three centuries in all.

Here again the present interest lies rather in the phases of change which are actually with us. During the first stages of the manufacturing period energy in any form was exceedingly difficult to transport, and this led to intense concentration. Coal was taken from the most accessible coalfield and used, as far as possible, on the spot. It was chiefly converted into mechanical energy by means of the steam-engine, an extremely wasteful apparatus in small units, and hence still further concentration; thus the steam-engine is responsible in part for the factory system in its worst aspect. The less accessible coalfields were neglected. Also, the only other really available source of energy—water-power—remained unused, because the difficulties in the way of utilising movements of large quantities of water through small vertical distances (as in tidal movements) are enormous; the only easily applied source occurs where comparatively small quantities of water fall through considerable vertical distances, as in the case of waterfalls. But, arising from the geographical conditions, waterfalls (with rare exceptions such as Niagara) occur in the "torrential" part of the typical river-course, perhaps far from the sea, almost certainly in a region too broken in surface to allow of easy communication or even of industrial settlement of any kind.

However accessible a coalfield may be to begin with, it sooner or later becomes inaccessible in another way, as the coal near the surface is exhausted and the workings get deeper. No doubt the evil day is postponed for a time by improvements in methods of mining—a sort of intensive cultivation—but as we can put nothing back the end must be the same, and successful competition with more remote but more superficial deposits becomes impossible. And every improvement in land transport favours the geographically less accessible coalfield.

From this point of view it is impossible to overestimate the importance of what is to all intents and purposes a new departure of the same order of magnitude as the discovery of the art of smelting iron with coal, or the invention of the steam-engine, or of the steam-locomotive. I mean the conversion of energy into electricity, and its transmission in that form (at small cost and with small loss) through great distances. First we have the immediately increased availability of the great sources of cheap power in waterfalls. The energy may be transmitted through comparatively small distances and converted into heat in the electric furnace, making it possible to smelt economically the most refractory ores, as those of aluminium, and converting such unlikely places as the coast of Norway or the West Highlands of Scotland into manufacturing districts. Or it may be transmitted through greater distances to regions producing quantities of raw materials, distributed there widespread to manufacturing centres, and reconverted into mechanical energy. The Plain of Lombardy produces raw materials in abundance, but Italy has no coal supply. The waterfalls of the Alps yield much energy, and this transmitted in the form of electricity, in some cases for great distances, is converting northern Italy into one of the world's great industrial regions. Chisholm gives an estimate of a possible supply of power amounting to 3,000,000 horse-power, and says that of this about one-tenth was already being utilised in the year 1900.

But assuming again, with Sir William Ramsay, that coal must continue to be the chief source of energy, it is clear that the question of accessibility now wears an entirely different aspect. It is not altogether beyond reason to imagine that the necessity for mining, as such, might entirely disappear, the coal being burnt *in situ* and energy converted directly into electricity. In this way some coalfields might conceivably be exhausted to their last pound without serious increase in the cost of getting. But for the present it is enough to note that, however inaccessible any coalfield may be from supplies of raw material, it is only necessary to establish generating stations at the pit's mouth and transport the energy to where it can be used. One may imagine, for example, vast manufactures carried on in what are now the immense agricultural regions of China, worked by power supplied from the great coal deposits of Shan-si.

There is, however, another peculiarity of electrical power which will exercise increasing influence upon the geographical distribution of industries. The small electric motor is a much more efficient apparatus than the small steam-engine. We are, accordingly, already becoming familiar with the great factory in which, instead of all tools being huddled together to save loss through shafting and belting, and all kept running all the time, whether busy or not (because the main engine must be run), each tool stands by itself and is worked by its own motor, and that only when it is wanted. Another of the causes of concentration of manufacturing industry is therefore reduced in importance. We may expect to see the effects of this becoming more and more marked as time goes on, and other forces working towards uniform distribution make themselves more felt.

The points to be emphasised so far, then, are, first, that the time when the available areas whence food supply as represented by wheat is derived are likely to be taxed to their full capacity within a period of about the same length as that during which the modern colonial system has been developing in the past; secondly, that cheap supplies of energy may continue for a longer time, although eventually they must greatly diminish; and, thirdly, there must begin in the near future a great equalisation in the distribution of population. This equalisation must arise from a number of causes. More intensive cultivation will increase the amount of labour required in agriculture, and there will be less difference in the cost of production and yield due to differences of soil and climate. Manufacturing industries will be more uniformly distributed, because energy, obtained from a larger number of sources in the less accessible places, will be distributed over an increased number of centres. The distinction between agricultural and industrial regions will tend to become less and less clearly marked, and will eventually almost disappear in many parts of the world.

The effect of this upon the third element is of first-rate importance. It is clear that as the process of equalisation goes on the relative amount of long-distance transport will diminish, for each district will tend more and more to produce its own supply of staple food and carry on its own principal manufactures. This result will naturally be most marked in what we may call the "east-and-west" transport, for as climatic controls primarily follow the parallels of latitude, the great *quantitative* trade, the flow of foodstuffs and manufactured articles to and fro between peoples of like habits and modes of life, runs primarily east and west. Thus the transcontinental functions of the great North American and Eurasian railways, the east-and-west systems of the inland waterways of the two continents, and the connecting links furnished by the great ocean ferries, must become of relatively less importance.

The various stages may be represented, perhaps, in some such manner as this. If **I** is the cost of producing a thing locally at a place A by intensive cultivation or what corresponds to it, if **E** is the cost of producing the same thing at a distant place B, and **T** the cost of transporting it to A, then at A we may at some point of time have a more or less close approximation to

$$\mathbf{I}=\mathbf{E}+\mathbf{T}.$$

We have seen that in this country, for example, **I** has been greater than **E+T** for wheat ever since, say, the introduction of railways in North America, that the excess tends steadily to diminish, and that however much it may be possible to reduce **T** either by devising cheaper modes of transport or by shortening the distance through which wheat is transported, **E+T** must become greater than **I**, and it will pay us to grow all or most of our own wheat. Conversely, in the 'seventies of last century **I** was greater than **E+T** in North America and Germany for such things as steel rails and rolling-stock, which we in this country were cultivating "extensively" at the time on more accessible coalfields, with more skilled labour and better organisation than could be found elsewhere. In many cases the positions are now, as we know, reversed, but geographically **I** must win all round in the long run.

In the case of transport between points in different latitudes the conditions are, of course, altogether dissimilar, for in this case commodities consist of foodstuffs, or raw materials, or manufactured articles, which may be termed luxuries, in the sense that their use is scarcely known until cheap transport makes them easily accessible, when they rapidly become "necessaries of life." Of these the most familiar examples are tea, coffee, cocoa and bananas, indiarubber and manufactured cotton goods. There is here, of course, always the possibility that wheat as a staple might be replaced by a foodstuff produced in the tropics, and it would be extremely interesting to study the geographical consequences of such an event as one-half of the surface of the earth suddenly coming to help in feeding the two quarters on either side; but for many reasons, which I need not go into here, such a consummation is exceedingly unlikely. What seems more probable is that the trade between different latitudes will continue to be characterised specially by its variety, the variety doubtless increasing, and the quantity increasing in still larger measure. The chief modification in the future may perhaps be looked for in the occasional transference of manufactures of raw materials produced in the tropics to places within the tropics, especially when the manufactured article is itself largely consumed near regions of production. The necessary condition here is a region, such as (*e.g.*) the monsoon region, in which there is sufficient variation in the seasons to make the native population laborious; for then, and apparently only then, is it possible to secure sufficient industry and skill by training, and therefore to be able to yield to the ever-growing pressure in more temperate latitudes due to increased cost of labour. The best examples of this to-day are probably the familiar ones of cotton and jute manufacture in India. With certain limitations, manufacturing trade of this kind is, however, likely to continue between temperate and strictly tropical regions, where the climate is so uniform throughout the year that the native has no incentive to work. There the collection of the raw material is as much as, or even more than can be looked for—as in the case of mahogany or wild rubber. Where raw material has to be cultivated—as cotton, cultivated rubber, &c.—the raw material has to be produced in regions more of the monsoon type, but it will probably—perhaps as much for economic as geographical reasons—be manufactured at some centre in the temperate zones, and the finished product transported thence, when necessary, to the point of consumption in the tropics.

We are here, however, specially liable to grave disturbances of distribution arising from invention of new machinery or new chemical methods; one need only mention the production of sugar or indigo. Another aspect of this which is not without importance may perhaps be referred to here, although it means the transference of certain industries to more accessible regions merely, rather than a definite change of such an element as latitude. I have in mind the sudden conversion of an industry in which much labour is expended on a small amount of raw material into one where much raw material is consumed, and by the application of power-driven machinery the labour required is greatly diminished. One remembers when a fifty-shilling Swiss watch, although then still by tradition regarded as sufficiently valuable to deserve enclosure in a case constructed of a precious metal, was considered a marvel of cheapness. American machine-made watches, produced by the ton, are now encased in the baser metals and sold at some five shillings each, and the watch-making industry has ceased to be specially suited to mountainous districts.

In considering the differences which seem likely to arise in what we may call the regional pressures of one kind and another, pressures which are relieved or adjusted by and along certain lines of transport, I have made a primary distinction between "east-and-west" and "north-and-south" types, because both in matters of food supply and in the modes of life which control the nature of the demand for manufactured articles climate is eventually the dominant factor; and, as I have said, climate varies primarily with latitude. This is true specially of atmospheric temperature; but temperature varies also with altitude, or height above the level of the sea. To a less extent rainfall, the other great element of climate, varies with latitude, but the variation is much more irregular. More important in this case is the influence of the distribution of land and sea, and more especially the configuration of the land surface, the tendency here being sometimes to strengthen the latitude effect where a continuous ridge is interposed, as in Asia, practically cutting off "north-and-south" communication altogether along a certain line, emphasising the parallel-strip arrangement running east and west to the north of the line, and inducing the quite special conditions of the monsoon region to the south of it. We may contrast this with the effect of a "north-and-south" structure, which (in temperate latitudes especially) tends to swing what we may call the regional lines round till they cross the parallels of latitude obliquely. This is typically illustrated in North America, where the angle is locally sometimes nearly a right angle. It follows, therefore, that the contrast of "east-and-west" and "north-and-south" lines, which I have here used for purposes of illustration, is necessarily extremely crude, and one of the most pressing duties of geographers at the present moment is to elaborate a more satisfactory method of classification. I am very glad that we are to have a discussion on "Natural Regions" at one of our sederunts. Perhaps I may be permitted to express the hope that we shall concern ourselves with the types of region we want, their structure or "grain," and their relative positions, rather than with the precise delimitation of their boundaries, to which I think we have sometimes been inclined, for educational purposes, to give a little too much attention.

Before leaving this I should like to add, speaking still in terms of "east-and-west" and "north-and-south," one word more about the essential east-and-west structure of the Old World. I have already referred to the great central axis of Asia. This axis is prolonged westward through Europe, but it is cut through and broken to such an extent that we may include the Mediterranean region with the area lying further north, to which indeed it geographically belongs in any discussion of this sort. But the Mediterranean region is bounded on the other side by the Sahara, and none of our modern inventions facilitating transport has made any impression upon the dry desert; nor does it seem likely that such a desert will ever become a less formidable barrier than a great mountain mass or range. We may conclude, then, that in so far as the Old World is concerned, the "north-and-south" transport can never be carried on as freely as it may in the New, but only through certain weak points, or "round the ends," *i.e.* by sea. It may be further pointed out that the land areas in the southern hemisphere are so narrow that they will scarcely enter into the "east-and-west" category at all—the transcontinental railway as understood in the northern hemisphere cannot exist; it is scarcely a pioneer system, but rather comes into existence as a later by-product of local east-and-west lines, as in Africa.

These geographical facts must exercise a profound influence upon the future of the British Isles. Trade south of the great dividing line must always be to a large extent of the "north-and-south" type, and the British Isles stand practically at the western end of the great natural barrier. From their position the British Isles will always be a centre of immense importance in *entrepôt* trade, importing commodities from "south" and distributing "east and west," and similarly in the reverse direction. This movement will be permanent, and will increase in volume long after the present type of purely "east-and-west" trade has become relatively less important than it is now, and long after the British Isles have ceased to have any of the special advantages for manufacturing industries which are due to their own resources either in the way of energy or of raw material. We can well imagine, however, that this permanent advantage of position will react favourably, if indirectly, upon certain types of our manufactures, at least for a very long time to come.

Reverting briefly to the equalisation of the distribution of population in the wheat-producing areas and the causes which are now at work in this direction, it is interesting to inquire how geographical conditions are likely to influence this on the smaller scale. We may suppose that the production of staple foodstuffs must always be more uniformly distributed than the manufacture of raw materials, or the production of the raw materials themselves, for the most important raw materials of vegetable origin (as cotton, rubber, &c.) demand special climatic conditions, and, apart from the distribution of energy, manufacturing industries are strongly influenced by the distribution of mineral deposits, providing metals for machinery, and so on. It may, however, be remarked that the useful metals, such as iron, are widely distributed in or near regions which are not as a rule unfavourable to agriculture. Nevertheless, the fact remains that while a more uniform distribution is necessary and inevitable in the case of agriculture, many of the conditions of industrial and social life are in favour of concentration; the electrical transmission of energy removes, in whole or in part, only one or two of the centripetal forces. The general result might be an approximation to the conditions occurring in many parts of the monsoon areas—a number of fairly large towns pretty evenly distributed over a given agricultural area, and each drawing its main food supplies from the region surrounding it. The positions of such towns would be determined much more by industrial conditions, and less by military conditions, than in the past (military power being in these days mobile, and not fixed); but the result would on a larger scale be of the same type as was developed in the central counties of England, which, as Mackinder has pointed out, are of almost equal size and take the name of the county town. Concentration within the towns would, of course, be less severe than in the early days of manufacturing industry. Each town would require a very elaborate and highly organised system of local transport, touching all points of its agricultural area, in addition to lines of communication with other towns and with the great "north-and-south" lines of world-wide commerce, but these outside lines would be relatively of less importance than they are now. We note that the more perfect the system of local transport, the less the need for points of intermediate exchange. The village and the local market-town will be "sleepy" or decadent as they are now, but for a different reason; the symptoms are at present visible mainly because the country round about such local centres is overwhelmed by the great lines of transport which pass through them; they will survive for a time through inertia and the ease of foreign investment of capital. The effect of this influence is already apparent since the advent of the "commercial motor," but up to the present it has been more in the direction of distributing from the towns than collecting to them, producing a kind of "suburbanisation" which throws things still further out of balance. The importance of the road motor in relation to the future development of the food-producing area is incalculable. It has long been clear that the railway of the type required for the great through lines of fast transport is ill-adapted for the detailed work of a small district, and the "light" railway solves little and introduces many complications. The problem of determining the direction and capacity of a system of roads adequate to any particular region is at this stage one of extraordinary difficulty; experiments are exceedingly costly, and we have as yet little experience of a satisfactory kind to guide us. The geographer, if he will, can here be of considerable service to the engineer.

In the same connection, the development of the agricultural area supplying an industrial centre offers many difficult problems in relation to what may be called accessory products, more especially those of a perishable nature, such as meat and milk. In the case of meat the present position is that much land which may eventually become available for grain crops is used for grazing, or cattle are fed on some grain, like maize, which is difficult to transport or is not satisfactory for bread-making The meat is then temporarily deprived of its perishable property by refrigeration, and does not suffer in transport. Modern refrigerating machinery is elaborate and complicated, and more suited to use on board ship than on any kind of land transport. Hence the most convenient regions for producing meat for export are those near the sea-coast, such as occur in the Argentine or the Canterbury plains of New Zealand. The case is similar to that of the "accessible" coalfield. Possibly the preserving processes may be simplified and cheapened, making overland transport easier, but the fact that it usually takes a good deal of land to produce a comparatively small quantity of meat will make the difficulty greater as land becomes more valuable. Cow's milk, which in modern times has become a "necessary of life" in most parts of the civilised world, is in much the same category as meat, except that difficulties of preservation, and therefore of transport, are even greater. That the problem has not become acute is largely due to the growth of the long-transport system available for wheat, which has enabled land round the great centres of population to be devoted to dairy produce. If we are right in supposing that this state of things cannot be permanent, the difficulty of milk supply must increase, although relieved somewhat by the less intense concentration in the towns; unless, as seems not unlikely, a wholly successful method of permanent preservation is devised.

In determining the positions of the main centres, or rather, in subdividing the larger areas for the distribution of towns with their supporting and dependent districts, water supply must be one of the chief factors in the future, as it has been in the past; and in the case of industrial centres the quality as well as the quantity of water has to be considered. A fundamental division here would probably be into districts having a natural local supply, probably of hard water, and districts in which the supply must be obtained from a distance. In the latter case engineering works of great magnitude must often be involved, and the question of total resources available in one district for the supply of another must be much more fully investigated than it has been. In many cases, as in this country, the protection of such resources pending investigation is already much needed. It is worth noting that the question may often be closely related to the development and transmission of electrical energy from waterfalls, and the two problems might in such cases be dealt with together. Much may be learned about the relation of water supply to distribution of population from a study of history, and a more active prosecution of combined historical and geographical research would, I believe, furnish useful material in this connection, besides throwing interesting light on many historical questions.

Continued exchange of the "north-and-south" type and at least a part of that described as "east-and-west" gives permanence to a certain number of points where, so far as can be seen, there must always be a change in the mode of transport. It is not likely that we shall have heavy freight-carrying monsters in the air for a long time to come, and until we have the aërial "tramp" transport must be effected on the surfaces of land and sea. However much we may improve and cheapen land transport, it cannot in the nature of things become as cheap as transport by sea. For on land the essential idea is always that of a prepared road of some kind, and, as Chisholm has pointed out, no road can carry more than a certain amount; traffic beyond a certain quantity constantly requires the construction of new roads. It follows, then, that no device is likely to provide transport indifferently over land and sea, and the seaport has in consequence inherent elements of permanence. Improved and cheapened land transport increases the economy arising from the employment of large ships rather than small ones, for not only does transport inland become relatively more important, but distribution along a coast from one large seaport becomes as easy as from a number of small coastal towns. Hence the conditions are in favour of the growth of a comparatively small number of immense seaport cities like London and New York, in which there must be great concentration not merely of work directly connected with shipping, but of commercial and financial interests of all sorts. The seaport is, in fact, the type of great city which seems likely to increase continually in size, and provision for its needs cannot in general be made from the region immediately surrounding it, as in the case of towns of other kinds. In special cases there is also, no doubt, permanent need of large inland centres of the type of the "railway creation," but under severe geographic control these must depend very much on the nature and efficiency of the systems of land transport. It is not too much to say (for we possess some evidence of it already) that the number of distinct geographical causes which give rise to the establishment and maintenance of individual great cities is steadily diminishing, but that the large seaport is a permanent and increasing necessity. It follows that aggregations of the type of London and Liverpool, Glasgow and Belfast will always be amongst the chief things to be reckoned with in these islands, irrespective of local coal supply or accessory manufacturing industries, which may decay through exhaustion.

I have attempted in what precedes to direct attention once more to certain matters for which it seems strangely difficult to get a hearing. What it amounts to is this, that as far as our information goes the development of the steamship and the railway, and the universal introduction of machinery which has arisen from it, have so increased the demand made by man upon the earth's resources that in less than a century they will have become fully taxed. When colonisation and settlement in a new country proceeded slowly and laboriously, extending centrifugally from one or two favourable spots on the coast, it took a matter of four centuries to open up a region the size of England. Now we do as much for a continent like North America in about as many decades. In the first case it was not worth troubling about the exhaustion of resources, for they were scarcely more than touched, and even if they were exhausted there were other whole continents to conquer. But now, so far as our information goes, we are already making serious inroads upon the resources of the whole earth. One has no desire to sound an unduly alarmist note, or to suggest that we are in imminent danger of starvation, but surely it would be well, even on the suspicion, to see if our information is adequate and trustworthy and if our conclusions are correct; and not merely to drift in a manner which was justifiable enough in Saxon times, but which, at the rate things are going now, may land us unexpectedly in difficulties of appalling magnitude.

What is wanted is that we should seriously address ourselves to a stocktaking of our resources. A beginning has been made with a great map on the scale of one to a million, but that is not sufficient; we should vigorously proceed with the collection and discussion of geographical data of all kinds, so that the major natural distributions shall be adequately known, and not merely those parts which commend themselves, for one reason or another, to special national or private enterprises. The method of Government survey, employed in most civilised countries for the construction of maps, the examination of geological structure or the observation of weather and climate, is satisfactory as far as it goes, but it should go further, and be made to include such things as vegetation, water supply, supplies of energy of all kinds, and, what is quite as important, the bearings of one element upon others under different conditions. Much, if not most, of the work of collecting data would naturally be done as it is now by experts in the special branches of knowledge, but it is essential that there should be a definite plan of a *geographical* survey as a whole, in order that the regional or distributional aspect should never be lost sight of. I may venture to suggest that a committee formed jointly by the great national geographical societies, or by the International Geographical Congress, might be entrusted with the work of formulating some such uniform plan and suggesting practicable methods of carrying it out. It should not be impossible to secure international cooperation, for there is no need to investigate too closely the secrets of anyone's particular private vineyard—it is merely a question of doing thoroughly and systematically what is already done in some regions, sometimes thoroughly, but not systematically. We should thus arrive eventually at uniform methods of stock-taking, and the actual operations could be carried on as opportunity offered and indifference or opposition was overcome by the increasing need for information. Eventually we shall find that "country-planning" will become as important as town-planning, but it will be a more complex business, and it will not be possible to get the facts together in a hurry. And in the meanwhile increased geographical knowledge will yield scientific results of much significance about such matters as distribution of populations and industries, and the degree of adjustment to new conditions which occurs or is possible in different regions and amongst different peoples. Primary surveys on the large scale are specially important in new regions, but the best methods of developing such areas and of adjusting distributions in old areas to new economic conditions are to be discovered by extending the detailed surveys of small districts. An example of how this may be done has been given by Dr. Mill in his "Fragment of the Geography of Sussex." Dr. Mill's methods have been successfully applied by individual investigators to other districts, but a definitely organised system, marked out on a carefully matured uniform plan, is necessary if the results are to be fully comparable. The schools of geography in this country have already done a good deal of local geography of this type, and could give much valuable assistance if the work were organised beforehand on an adequate scale.

But in whatever way and on whatever scale the work is done, it must be clearly understood that no partial study from the physical, or biological, or historical, or economic point of view will ever suffice. The urgent matters are questions of distribution upon the surface of the earth, and their elucidation is not the special business of the physicist, or the biologist, or the historian, or the economist, but of the geographer.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Leeds.—In connection with the work on animal nutrition which is being conducted under a grant from the Development Commissioners, Dr. H. W. Dudley, of the Herter Research Laboratory, New York, has been appointed lecturer in biochemistry. The experimental station in flax growing, which is also supported by the Development Commissioners, has been placed under the direction of Mr. F. K. Jackson, formerly of the agricultural departments of the Universities of Leeds and Cambridge.

London.—The following courses of advanced science lectures are announced:—"The Cytology and Affinities of the Higher Fungi," by Dr. Gwynne-Vaughan, at University College, beginning on October 23; "The Physiological Significance of Acidosis," by Drs. Kennaway and Poulton, at Guy's Hospital, beginning on October 9; "The Cerebro-spinal Fluid," by Profs. Halliburton and Dixon, at King's College, beginning on November 3; "Mechanism and Teleology," by Prof. Hans Driesch, at King's College, beginning on October 21; "The Theory of Heat in Relation to Atmospheric Changes," by Dr. W. N. Shaw, F.R.S., at the Meteorological Office, beginning on January 23. All the lectures are free.

The Maharaja Scindia of Gwalior has contributed 25,000 rupees to the Yunani Vedic Medical College at Delhi.

Dr. T. Franklin Sibly, lecturer in geology at King's College, London, has been appointed professor of geology in the University College of South Wales and Monmouthshire, Cardiff.

The report by cable that Mr. W. Robbie, a pioneer gold-digger, who died at Ballarat a short time ago, had left a large bequest to the University of Aberdeen, has been confirmed by mail. The estimated amount of the bequest, however, is 23,000*l.*—not 30,000*l.* as at first reported—and it is to be applied for scholarships in mathematics, natural philosophy, and chemistry.

SOCIETIES AND ACADEMIES.

New South Wales.

Linnean Society, July 30.—Mr. W. S. Dun, president, in the chair.—T. G. **Sloane**: Revisional notes on Australian Carabidæ. Part iv., The genus Notonomus. The number of species recognised is eighty-nine, of which fifteen are proposed as new.—J. J. **Fletcher**: A case of natural hybridism in the genus Grevillea (N.O. Proteaceæ. *Grevillea laurifolia*, Sieb., and *G. acanthifolia*, A. Cunn., are two common and characteristic members of the flora of the higher portion of the Blue Mountain area. Certain other rare forms are sometimes associated with one or both of them, some of which have been described under the name of *G. gaudichaudii*, R. Br. The object of this paper is to justify the contention, that the rare plants to which the name *G. gaudichaudii*, R. Br., has been applied, or is applicable, form one group only of a series of transitional forms between *G. laurifolia and G. acanthifolia*, of which another, equally remarkable, group has escaped notice; that the entire series is one series of naturally related forms; and that the explanation of their real relationship is, that they are hybrids between the two species mentioned. Seven recognisably different types are described. The two parent-species are markedly contrasted in most of their morphological characters, in their habit of growth, and in being members of two different plant-associations and consequently in their habitats; but cross-pollination is possible, because the racemes of both are of the same pattern (elongated and secund). As the two species belong to different plant-associations, the conditions favouring cross-pollination arise only at or close to the boundary between them, while circumstances prevent the hybrids from spreading laterally.

BOOKS RECEIVED.

Papers and Proceedings. Seventh Annual Meeting, American Sociological Society held at Boston, Mass., December 28, 30, 31, 1912. Vol. vii. Pp. vi+223. (Chicago, Ill.: University of Chicago Press; Cambridge, England: University Press.) 6*s*. net.

Moths of the Limberlost. By Gene S. Porter. Pp. xiv+370. (London: Hodder and Stoughton.) 10*s*. 6*d*. net.

Pedagogical Anthropology. By M. Montessori. Translated from the Italian by F. T. Cooper. Pp. xi+508. (London: William Heinemann.) 14*s*. net.

Proceedings of the Aristotelian Society. New series. Vol. xiii. Containing the Papers read before the

Society during the Thirty-fourth Session, 1912–13. Pp. 375. (London: Williams and Norgate.) 10s. 6d. net.

The Golden Bough: a Study in Magic and Religion. By Prof. J. G. Frazer. Third edition. Part vi. The Scapegoat. Pp. xiv+453. (London: Macmillan and Co., Ltd.) 10s. net.

Contributions from the Jefferson Physical Laboratory of Harvard University for the Year 1912. Vol. x. (Cambridge, Mass.; U.S.A.)

Preliminary Statistics of Nebulae and Clusters. By C. V. L. Charlier. Pp. 35+11 plates. (Upsala and Stockholm: Almqoist and Wiksell; London: Wesley and Son.)

Armstrong College, Newcastle-upon-Tyne. Calendar. Session 1913–14. Pp. 514. (Newcastle-upon-Tyne.) 1s.

Forty-Third Annual Report of the Entomological Society of Ontario, 1912. Pp. 143. (Toronto: Department of Agriculture.)

Fire Tests with Doors, by Chubb and Sons' Lock and Safe Co., Ltd., London. The Committee's Report. Pp. 20. ("Red Books" of the British Fire Prevention Committee, No. 183.) (London: The British Fire Prevention Committee.) 2s. 6d.

Organic Chemistry for Students of Medicine. By Prof. J. Walker, F.R.S. Pp. xi+328. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd.) 6s. net.

University of Bristol. Calendar, 1913–14. Pp. 304. (Bristol.)

La Catalyse en Chimie Organique. By P. Sabatier. Pp. xiv+255. (Paris and Liege: Libraire Ch. Beranger.) 12.50 francs.

The New Encyclopædia. Edited by H. C. O'Neill. Pp. vii+1626. (London and Edinburgh: T. C. and E. C. Jack.) 7s. 6d. net.

A Leisurely Tour in England. By J. J. Hissey. Pp. xviii+396+plates. (London: Macmillan and Co., Ltd.) 10s. net.

The National University of Ireland. Calendar for the Year 1913. Pp. 480. (Dublin; London: Longmans, Green and Co.)

Eighth Annual Report of the Meteorological Committee to the Lords Commissioners of H.M. Treasury. For the year ended March 31, 1913. Pp. 68. (London: H.M. Stationery Office; Wyman and Sons, Ltd.) 1s.

The Realm of Nature: an Outline of Physiography. By Dr. H. R. Mill. Second edition. Pp. xii+404+maps. (London: J. Murray.) 5s.

Materials and Methods in High School Agriculture. By Prof. W. G. Hummel and Bertha R. Hummel. Pp. xi+385+plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5s. 6d. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Liefs 56–59. (Jena: G. Fischer.) 2.50 marks each part.

A History of University Reform from 1800 A.D. to the Present Time. With Suggestions towards a Complete Scheme for the University of Cambridge. By A. I. Tillyard. Pp. xv+392. (Cambridge: W. Heffer and Sons, Ltd.) 10s. net.

Proceedings of the Prehistoric Society of East Anglia for 1912–13. Vol. i. Part iii. Pp. 245–382+plates lix–cxvii. (London: H. K. Lewis.) 3s. 6d. net.

Modern Problems in Psychiatry. By Prof. E. Lugaro. Translated by Dr. D. Orr and Dr. R. G. Rows. Second edition. Pp. vii+305. (Manchester: University Press; London: Sherratt and Hughes.) 7s. 6d. net.

Wireless Telegraphy and Telephony without Wires. By C. R. Gibson. Pp. 156. (London: Seeley, Service and Co., Ltd.) 2s. net.

Things Seen in Oxford. By N. J. Davidson. Pp. 258+plates. (London: Seeley, Service and Co., Ltd.) 2s. net.

Aeroplanes in Gusts. Soaring Flight and the Stability of Aeroplanes. By S. L. Walkden. Second edition. Pp. xxv+280+iv plates. (London: E. and F. N. Spon, Ltd.) 12s. 6d. net.

E. Merck's Annual Report of Recent Advances in Pharmaceutical Chemistry and Therapeutics, 1912. Vol. xxvi. Pp. 524+xix. (Darmstadt and London: E. Merck.) 1s. 6d.

Metallography. By Dr. C. H. Desch. Second edition. Pp. xi+431+xiv plates. (London: Longmans, Green and Co.) 9s.

New South Wales. Department of Mines. Mineral Resources, No. 7. Mercury or "Quicksilver" in New South Wales. Second edition. Pp. 53+maps. (Sydney, N.S.W.) 2s. 6d.

The University of Leeds. Calendar, 1913–14. Pp. 666. (Leeds.)

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 3.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—The Testing of Gas Engines: W. A. Tookey.

MONDAY, OCTOBER 6.

SOCIETY OF ENGINEERS, at 7.30.—Highways: C. H. Cooper.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2293, Vol. 92] THURSDAY, OCTOBER 9, 1913 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, OCTOBER 9, 1913.

HAUSA FOLK-LORE AND CUSTOMS.

Hausa Folk-Lore, Customs, Proverbs, &c., Collected and Transliterated with English Translation and Notes. By R. Sutherland Rattray. With a preface by R. R. Marett. Vol. i., pp. xxiv+327; vol. ii., pp. 315. (Oxford: Clarendon Press, 1913.) Price, 2 vols., 30*s.* net.

THIS book is intended to serve two distinct objects: to serve as a chrestomathy of the Hausa language, and as a collection of the local folk-lore and custom. It contains a series of lithographed Hausa texts, with a transliteration in Roman characters and a literal English translation. The method employed is to reproduce the MSS. written by a learned Hausa Málam or scribe, who wrote down or translated from Arabic sources such information as was required, and this was subsequently translated into Hausa. By this process the primary intention of the work is satisfactorily attained. Mr. Rattray is obviously a competent scholar, and in the course of the work he has been able to correct or extend the work of previous writers on Hausa grammar and phonology.

These admirably printed volumes thus represent a substantial contribution to linguistics, but the attempt to collect folk-lore and custom is not quite so satisfactory. The learned native scribe, like the Indian Pundit or Moulvi, is not the best agent for exploring the peasant beliefs and usages. He is apt to regard popular tradition and custom as of little value when they do not happen to conform to his standard of orthodoxy, and to introduce into his material something which is of purely literary origin and does not smell of the soil. In this respect Major Tremearne, in his recently published "Hausa Superstition and Custom," seems to have followed a sounder method by recording in his own hand the tales and superstitions which he heard from the lips of privates in the Nigeria Regiment, peasants, women and children.

Mr. Rattray has arranged his material in five divisions: traditionary accounts of the origin of the Hausa nation and of their conversion to Islam; tales of heroes and heroines; animal tales; customs and arts; proverbs. Among the tales we find many familiar *motifs* and incidents—the cannibal giant with his "Fee-fo-fum"; Beauty and the Beast, and so on. The animal tales are decidedly the best in the collection, and well illustrate the naïve cunning and wit which characterise the race. The formulæ introducing and closing the tales are interesting. They begin with "This is a story about" so and so; "a tale, let it go, let it come," ending with "Off with the rat's head!" that is, "that is the end of him."

The accounts of custom are rather disappointing, because, unless the Málam is mistaken, Islam has crushed down most of the indigenous practices. Perhaps the most valuable chapters are those describing, from native sources, the *cire perdue* process of brass-casting, as it appears in the remarkable figures from Benin, and an account of the primitive method of tanning skins.

The book, as a whole, deserves hearty commendation. But in his next attempt to add to his stores of local folk-lore and usage Mr. Rattray might with advantage dispense with the services of his Málam and depend upon himself for the task of collection.

INDIAN CHRONOGRAPHY.

Indian Chronography: An extension of the "Indian Calendar," with working examples. By Robert Sewell. Pp. xii+187. (London: George Allen & Co., Ltd., 1912.) Price 31*s.* 6*d.* net.

HINDU chronology appears extremely complex at first glance, but this complexity is more apparent than real, being largely due to the fact that so many different systems of reckoning were used in different places and at different times. Each single system is comparatively simple, and—save for the neglect of the effects due to precession—fairly accurate. The standard work on the subject is the "Indian Calendar," by Messrs. Sewell and Dikshit (NATURE, vol. liv., No. 1393), to which the present volume forms a supplement.

We have here a condensed account of those systems of chronology usually met with in inscriptions and documents, which are more fully treated in the previous work. Some space is devoted to the tropical year in view of the fact that this unit is occasionally met with, while the method of reckoning by Jovian Saṁvatsaras is fully described.

The volume contains a very large number of carefully worked examples and numerous tables, numbered to run consecutively with those of the previous volume. These include tables for the conversion of the moment of Mēsha Saṁkrānti by the First Arya Siddhānta into the same moment of the Present Sūrya Siddhānta; tables of the sixty- and twelve-year cycles of Jupiter, &c. Table I. of the "Indian Calendar" is carried forward to A.D. 1950; while Tables W, Y, Z (now XXXIII., XXXIV., XXXV.) of the Additions and Corrections to the "Indian Calendar" reappear. In Table XXXIII., "For finding the mean place of Jupiter," the argument is now the time interval from the epoch of the Kaliyuga, so that the table is available for more than 3000 years further back; while Table XXXIV. is now given for days, hours, and minutes, instead of days, ghatikās, and palas.

The tables are clearly printed and the volume is furnished with a comprehensive index. To the Indian epigraphist and many others the volume should prove a welcome supplement to the "Indian Calendar."

R. J. Pocock.

THE ANTIQUITY AND EVOLUTION OF MAN.

(1) *Man and His Forerunners.* By Prof. H. v. Buttel-Reepen. Incorporating Accounts of Recent Discoveries in Suffolk and Sussex. Authorised Translation by A. G. Thacker. Pp. 96. (London: Longmans, Green and Co., 1913.) Price 2*s.* 6*d.* net.

(2) *The Origin and Antiquity of Man.* By Dr. G. Frederick Wright. Pp. xx+547. (London: John Murray, 1913.) Price 8*s.* net.

(3) *L'Uomo Attuale una Specie Collettiva.* By V. Giuffrida-Ruggeri. Pp. viii+192+xiii plates. (Milano: Albrighi, Segati e C., 1913.) Price 6 lire.

(4) *Die Rehobother Bastards und das Bastardierungsproblem beim Menschen.* Dr. Eugen Fischer. Pp. vii+327+19 plates. (Jena: Gustav Fischer, 1913.) Price 16 marks.

(1) IN this excellent translation of Prof. Buttel-Reepen's little book, with the German title altered to "Man and His Forerunners," the statement occurs that "general treatises on Pleistocene man published before 1908 are now almost valueless." Such a statement implies that our knowledge regarding the ancestry and evolution of man has been revolutionised in the last five years —a statement which no one familiar with the subject could support for a moment. Yet in that space of time certain events have occurred which do materially alter our conception of how and when mankind came by its present estate.

There is, in the first place, the discovery of definite types of worked flints beneath the Red Crag of East Anglia by Mr. J. Reid Moir. Prof. von Buttel-Reepen does not question that the sub-Crag flints show human workmanship, but he seeks to minimise their antiquity by withdrawing the Red Crag from the Pliocene formations and setting it at the commencement of the Pleistocene series—a change which we believe geologists will not be inclined to countenance. Even if the place of the Red Crag be changed to the commencement of the Pleistocene, the sub-Crag flints may still claim a respectable antiquity, for the author quotes with approval Penck's estimate of 500,000 to 1,500,000 years as the duration of the Pleistocene period, and 25,000 years as the time which has elapsed since the Pleistocene closed.

It is during the last five years that we have come to realise fully the significance of Neanderthal man. He was formerly regarded as our Pleistocene ancestor. The recent discoveries in France and a more exact study of prehistoric remains have made amply clear that Neanderthal man is so sharply differentiated in all his features from modern man that we must regard him not as an ancestor, but as a totally different and collateral species, and that in past times there was not one species of man—subdivided into varieties as at present—but that there existed several, perhaps many, different species of man.

We note that Prof. von Buttel-Reepen gives his adhesion to the theory of multiple human species. On the other hand, we also observe that Dr. Frederick Wright, in the "Origin and Antiquity of Man," adopts the view, usually held by geologists, that Neanderthal man is merely a variant of modern man, and brings forward the time-worn examples of Robert the Bruce and the mediæval Bishop of Toul as representatives of Neanderthal man in modern times. The difference between the crania of Robert the Bruce and Neanderthal man is almost as great as that which separates the skulls of the chimpanzee and gorilla.

The third event which has altered our conception of man in the past is the discovery made by Mr. Charles Dawson in a pocket of gravel by the side of a farm-path, at Piltdown, Sussex. The discovery is noted by three of the authors whose books are here reviewed, and it is interesting to see what opinion each of them has formed of *Eoanthropus dawsoni.* Prof. von Buttel-Reepen gives us the first surprise; he places this new species of humanity with Neanderthal man, between the second and third glacial phases of the Pleistocene. It is true that Mr. Dawson and Dr. Smith Woodward did use the term Chellean—which refers to the stage of flint workmanship usually supposed to have been reached between the second and third of Penck's glacial phases—but they were also careful to explain that they regarded the Piltdown gravel as having been deposited and the skull imbedded at a period long anterior to the Chellean age—namely, at the early part of the Pleistocene period—perhaps earlier.

As to the position of Eoanthropus in the human lineage, all our authors show circumspection. Prof. von Buttel-Reepen is "inclined to think that the anterior curve of the jaw passed more sharply upwards than in Woodward's reconstruction, and that the whole front of the jaw, and consequently the front teeth, were somewhat smaller and more human than he believes." There is no doubt this is the case; a close study of the faithful replicas of the jaw which are now freely in circulation will show that there is neither indication of, nor accommodation for, the large canine tooth postulated by Dr. Smith Woodward. It is true the conformation of the chin is purely simian. It is a feature never before observed in a human skull, but a simian chin does not necessarily indicate a large canine tooth.

The discovery at Piltdown evidently puzzled the author of "l'Uomo Attuale"—Prof. Giuffrida-Ruggeri, of Naples, one of the most expert anthropologists in Europe. He is naturally puzzled by the statement of the discoverers that they regard Eoanthropus as a contemporary of the Heidelberg man, and that flints of the Chellean type were found with the remains—flints of that type belonging to a much later date than that of the Heidelberg jaw. He adds that it was impossible for him to make any further statement regarding the nature of Eoanthropus until figures, or, better still, actual models of the remains were at his disposal. By this time such models are probably at the Neapolitan professor's disposal, and he will have noted, as students of anatomy are certain to observe, that owing to the manner in which the bones of the skull-case have been put together, the brain-size of Eoanthropus has been greatly under-estimated. The size of brain is that of modern man—somewhere about, or a little above, 1500 cubic centimetres. The importance of the discovery of Eoanthropus will be thus apparent. At an early part of the Pleistocene period, perhaps much earlier, there existed human beings with a brain of the modern size, but a chin which was purely simian in conformation.

(2) In discovering the evidence on which the long-past history has to be based three classes of men are involved—the geologist, the archæologist (or lithologist), and the anatomist. It is unlikely that any one man could attain such a knowledge as to become an expert in all three lines of investigation. The geologist must be our time-keeper and time-marker, especially as regards the Pleistocene—the geologist who has paid special attention to the evidence relating to the phases of glaciation. For this reason a work on the origin and antiquity of man, by Dr. Frederick Wright, who has been a life-long student of the glacial phenomena of North America, is of especial value. There is nothing concerning the origin of man in Dr. Wright's book, but much which bears on the length of the Pleistocene period and the relation of man to that period. Penck, from his studies of the glacial deposits in Europe, estimates that the Pleistocene was at least half a million years in duration, perhaps a million and a half. Dr. Frederick Wright's investigations in America have led him to infer that 80,000 years is an ample estimate of the duration of the Ice age from its inception to its close. He admits the existence of pre-Glacial man. "Large areas," he writes, "in Europe and North America which are now principal centres of civilisation were buried under glacial ice thousands of feet thick, while the civilisation of Babylonia was in its heydey (5000 B.C.). . . . Both in its inception and in its close the Glacial epoch was a catastrophe of the most impressive order. No reasoning from present conditions can apply to the Glacial epoch without great reservation."

It will thus be seen that Dr. Frederick Wright has returned to the manner of thinking which was prevalent before the days of Lyell. He is an advocate of "Paroxysms of Nature." By a paroxysm of human evolution—one is inclined to substitute the word "miracle"—he thinks the early civilisation of Babylon and of Egypt may have hurriedly arisen and primitive mankind become separated into the well-marked varieties which are seen in our present-day world. It must also be noted that the duration assigned to the last phase of glaciation by Dr. Wright is in complete agreement with the computations given by the late General Drayson. In one matter especially anthropologists are much beholden to Dr. Wright. He has no hesitation in declaring that the human skeletons found under the loess at Lancing on the Missouri and at Omaha, Nebraska, lay under undisturbed glacial deposits, and the remains were those of men who lived in America in the Glacial period. The importance of the statement lies in the fact that these men were of the modern type—in one case exactly of the Red Indian type.

(3) Prof. Giuffrida Ruggeri's book deals with another aspect of the problem of man's origin. Its inception dates from his visit to London two years ago, when he attended the Universal Races Congress. He was surprised to hear the speculations of Prof. Klaatsch regarding the independent origin of human races—brought forward by those who took part in the discussions of the congress—as if they were facts accepted by all anthropologists. It will be remembered that Prof. Klaatsch saw fanciful resemblances between certain races of mankind and certain anthropoids, and supposed such races and anthropoids had sprung together from a common stock. In the process of dismembering Prof. Klaatsch's theory, the Neapolitan pro-

fessor has done anthropologists a great service by bringing together and systematising all recent investigations concerning the origin and nature of modern races of mankind. He regards the human race not as an "ideal" species—one composed of a predominant single variety: it would become so if one race prevailed and exterminated all the others—but as a collective species comprising many varieties of equal value in the eye of the classifier. His classification of modern races is a very practical one.

(4) We have kept the most important of the four books here reviewed to the last—for there can be no doubt, from every point of view, that Prof. Eugen Fischer's book merits such commendation. What happens when two diverse races of mankind interbreed throughout a long series of generations? Is a new race of mankind thus produced—a race which will continue to reproduce characters intermediate to those of the parent stocks? At the present time such an opinion is tacitly accepted by most anthropologists. It was to test the truth of such an opinion that Dr. Eugen Fischer, professor of anthropology at Freiburg, with financial assistance from the Royal Academy of Sciences of Berlin, set out to investigate the Bastard people in the Rehoboth district of German South-West Africa. The Rehoboth Bastards form a community of 2500–3000 souls, and are the result of intermarriage between early Boer farmers and Hottentot women—an intermixture which began more than a century ago.

This book contains the results of Prof. Fischer's investigations and is a model for those who will follow in his footsteps. His observations have convinced him that a new and permanent human race cannot be formed by the amalgamation of two diverse forms of man—not from any want of fertility—for amongst the Bastards there is an average of 7·4 children to each family—but because certain characters are recessive, others are dominant, and the original types tend to reassert themselves in the course of generations, according to Mendel's law. Although the mean head-form of the Bastards is intermediate to those of the two parent races—Hottentot and Boer—yet in each generation a definite number of the Bastards tend to assume the head-form of the one or of the other of the parent races. There are certain facts relating to head-form known to English anthropologists which can be explained only on a Mendelian basis and are in harmony with Dr. Fischer's observations. Between three and four thousand years ago England was invaded by a race with peculiarly formed, short and high heads. During those thousands of years the Bronze age invaders have been mingling their blood with that of the older and newer residents of England. Yet in every gathering of modern Englishmen—especially of the middle classes—one can see a number of pure examples of the Bronze age head-form. On the Mendelian hypothesis the persistence of such a head-form is explicable.

Dr. Eugen Fischer's study of the Rehoboth Bastards will be welcomed by all students of heredity. No race has so many peculiar human traits as the Hottentots, and hence the laws of human inheritance—as Prof. Fischer was the first to recognise—can be advantageously studied in their hybrid progeny.

"FLORAS" AND PLANT MONOGRAPHS.

(1) *A Manual Flora of Egypt.* By Dr. Reno Muschler. With a preface by Prof. Paul Ascherson and Prof. Georg Schweinfurth. Two volumes. Pp. xii+1312. (Berlin: R. Friedländer und Sohn, 1912.)

(2) *Bush Days.* By Amy E. Mack. With illustrations from photographs by J. Ramsay and L. Harrison. Pp. xii+132. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Company, 1911.) Price 3*s*. 6*d*. net.

(3) *The Flora of Bristol: Being an account of all the Flowering Plants, Ferns, and their Allies that have at any time been found in the district of the Bristol Coal-Fields.* By J. W. White. Pp. ix+722+3 plates+map. (Bristol: John Wright & Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1912.) Price 13*s*. 6*d*. net.

(4) *Pflanzengeographische Monographie des Berninagebietes.* By Dr. E. Rübel. Pp. x+615+xxxvi plates. (Leipzig: W. Engelmann, 1912.) Price 8 marks.

(5) *Das Pflanzenreich: Regni vegetabilis conspectus.* Herausgegeben von A. Engler. 53 Heft. iv. 129. Geraniaceæ. By R. Knuth. Pp. 640. Price 32 marks. 54 Heft. iv. 277 u. 277*a*. Goodeniaceæ und Brunoniaceæ. By K. Krause. Pp. 207+6. (Leipzig: W. Engelmann, 1912.) Price 10.80 marks.

(1) DR. MUSCHLER'S "Flora of Egypt" has grown from the work of Ascherson and Schweinfurth, whose "Illustration de la flora d'Egypte," published in 1887, was the first modern account of the vegetation of the country. In this work 1215 species were enumerated, and the number was increased in a supplement, issued two years later, to 1316. In the preparation of the present work, Dr. Muschler has had the advantage of the unpublished additional notes by the two veteran workers and also the use of their extensive herbarium. The number of species (of flowering plants and ferns) is brought up to 1505,

which, however, includes about 180 cultivated plants.

The work is in English and comprises adequate descriptions of the families, genera, species, and varieties; the systematic arrangement is that of Engler's Syllabus. Under each species references are given to relevant synonymy, and the distribution in the area under consideration is worked out in detail. About one-third of the second volume is occupied by a series of appendixes, including (1) a brief account of botanical work in Egypt; (2) a phytogeographical subdivision of the area into five districts—Mediterranean, Nile-delta, Oases of the Libyan Desert, Desert region, and Red Sea region; (3) a tabulated list of all the species and their distribution in these districts; (4) a similar table showing the distribution of Egyptian species in the Mediterranean basin; (5) a list of the commoner cultivated and garden plants; (6) a glossary; and (7) a list of Arabian names. The "Flora" forms a useful working handbook to the plants of Lower Egypt, and will be much valued by those interested in the botany of this ancient land.

(2) Miss Mack's "Bush Days" is a readable little volume consisting of short chapters on the plants and birds, and their habitats, which are still to be found within easy reach of Sydney. The letterpress is illustrated by numerous well-executed photographic reproductions, and the book, though obviously written for the author's near neighbours, may be read with interest and profit by lovers of nature in other parts of the world.

(3) Mr. White's "Flora of Bristol," described as "the outcome of an ideal hobby, cultivated in the spare moments of a business career," is a good example of a modern local flora. As no descriptions of genera and species are given, it must be used in association with a general "British Flora," but it is rich in critical notes on the plants and their occurrence within the limits of the area under consideration. Full details of habitat are given—a circumstance which will, it is hoped, not lead to the extinction of some of the rarer forms by greedy or over-zealous collectors. 1138 flowering plants are recorded as native or colonists, and a number of aliens are also included in smaller type. Ferns and Characeæ bring the total up to 1178. The number is likely to decrease, as some of the rarer plants are noted as less common than formerly and as extinct in former localities. Mr. White mentions 193 species as rare or local and 218 as very rare. Three, formerly native, are now extinct, namely, sea-kale (*Crambe maritima*), the rare galingale (*Cyperus longus*), which, formerly abundant in a single locality, has been exterminated by draining and cultivating, and a sedge (*Carex Davalliana*), found a century ago near Bath, but long since destroyed by drainage. The last species is of interest as having supplied the figured specimen for "English Botany."

In addition to the systematic portion, Mr. White gives a valuable introduction, including notes on the geology of the district and an analysis of the flora in relation to the different geological areas. There is also an interesting history of Bristol botany, with biographical notices of botanists, from William Turner, the father of English botany, who as Dean of Wells spent some years in the district, onwards to recent workers.

(4) Botanists who have visited the Engadine will turn with interest to Dr. Rübel's exhaustive account of the plant-geography of the Bernina district. The author is a pupil of Dr. Schröter, and his book is a tribute to the well-known zeal of his teacher in the ecological study of the botany of the Swiss Alps. Factors of climate, soil, and position are studied in detail, and a useful account is given of the various plant-formations. There is also a complete flora of the district, including flowering plants and cryptogams, in the elaboration of which Dr. Rübel has had the help of specialists in the various groups. A notable feature of the book are the beautiful photographic reproductions; and there is also an excellent folding map.

(5) Dr. R. Knuth's contribution to "Das Pflanzenreich"— a monograph of the Geraniaceæ —is one of the most important of this series. It is of interest to the horticulturist as well as to the botanist, as it includes an elaborate account of the hybrids of the genus Pelargonium, the source of the so-called geraniums and zonal pelargoniums of our gardens. The plan of the volume is similar to that of the other monographs of the series—a general account of the vegetative and floral morphology and the distribution of the family, followed by a detailed systematic description of the genera, species, and varieties, a fair proportion of which are illustrated in the eighty plates. Dr. Knuth recognises about 600 species, 259 of which are included in Geranium (to which belong our crane's-bills), while 232 belong to the great South African genus Pelargonium. Erodium—including our stork's-bill—has sixty species. These three great genera, with two less important, form the tribe Geranieæ, characterised by the twisted beak of the fruit—the remaining six genera, the fruit of which is not beaked, show greater diversity of floral structure, and are distributed among four small tribes.

Dr. Krause has elaborated for the same series of monographs the two families Goodeniaceæ and

Brunoniaceæ, members of the sympetalous series Campanulatæ. The former is a small but important Australian family with about 300 species; the latter is a monotypic group, restricted to a single species, *Brunonia australis*, a small perennial herb of somewhat daisy-like habit, widely distributed in Australia. It is interesting to note that the wealth of Australian material preserved in the great herbaria at the British Museum and Kew have supplied a large proportion of the material on which Dr. Krause's monographs are based. A. B. R.

OUR BOOKSHELF.

Le Monde Polaire. By Otto Nordenskjöld. Traduit du Suédois par G. Parmentier and M. Zimmermann. Préface du Dr. J. Charcot. Pp. xi+324+xx plates. (Paris: Librairie Armand Colin, 1913.) Price, 5 francs.

Here is a handbook to the Polar regions, dealing, not with the exploration (of such there are plenty), but with the physical conditions of the regions, for which there was a vacant place. It is well for readers outside Scandinavia that it has been translated from the original Swedish into French: it might well be so into English. In a sense it treats the two polar regions as one, for it is comparative throughout, and for that reason the chapters are not arranged in a topographical sequence. Thus we have successive chapters devoted to Greenland, Iceland, and Spitsbergen; the next chapter deals with the Antarctic lands. The writer ranges widely enough to include among "sub-antarctic" lands Patagonia and Tierra del Fuego, the Falkland and other islands, and New Zealand, so far as that Dominion can be considered to lie under such conditions; correspondingly we find chapters on Arctic America (including Labrador), on Siberia, and on north-western Europe. Numerous photographs and sketch-maps accompany the text, and the French translation, which is prefaced by an introduction by Dr. J. Charcot, appears to have been excellently carried out by MM. G. Parmentier and M. Zimmermann. Dr. Nordenskiöld's chapters deal with the relief of land, ice conditions and effects, plant and animal distribution, climatic conditions and human life, and, where appropriate, with economic products.

Coast Erosion and Protection. By E. R. Matthews. Pp. xiv+147+33 plates. (London: C. Griffin and Co., Ltd., 1913.) Price 10*s*. 6*d*. net.

The author of this book writes with a practical knowledge of the subject with which he deals. He holds the position of Borough Engineer of Bridlington, and has constructed sea walls, promenades, and sea defence works of considerable magnitude, which are good examples of what such work should be.

The book follows much the same lines as that on the Destruction, Littoral Drift, and Protection of the Sea Coast, published by Messrs. Longman and Co. in 1902, but it does not treat the question of Littoral Drift with the same detail. As that book is now out of print, and the author of the present book has had the advantage of the large body of evidence laid before the Royal Commission on Coast Erosion, this work will be a valuable aid to engineers called upon to take charge of sea defence works.

The text is very fully illustrated with numerous plates showing the effect of waves on sea walls and cliffs in course of erosion, and illustrations of sea walls, groynes, and other sea defence works. As these latter are clearly drawn, and have the dimensions of the several parts marked on, they cannot fail to be of great practical use.

The book is divided into twelve chapters, the subjects dealt with being: wave action; erosion and accretion of the shore; types and designs of sea walls; groynes; reinforced concrete; and the action of sea water on cement and concrete.

In his account of the erosion of the Yorkshire coast, the author repeats the old fallacy of the material eroded from those cliffs being carried southward by the tides and being deposited on the Lincolnshire shore, and also as being carried up the Humber. This subject was fully dealt with in a paper on the source of warp in the Humber, read before the Geological Section of the Glasgow meeting of the British Association in 1901, in which it was shown that it is practically impossible for this eroded material to be carried so far southward; and samples of water taken on several occasions of the water entering the Humber on the flood tide give no indication of alluvial matter being carried into that river.

I Fenomeni Magnetici Nelle Varie Teorie Elettro-Magnetiche. Note Storico-Critiche. By Silvio Magrini. Pp. 165. (Bologna: Nicola Zanichelli, 1912.)

The scope of this interesting little volume, by an Italian author, is novel to English readers; at least, the present writer cannot recollect any other book devoted entirely to the history of the theory of magnetism. Oersted's fundamental discovery that an electric current gives rise to a magnetic field in surrounding space was important, not only as the starting point of electromagnetism, but also because, in the hands of Ampère, it became the basis of a theory designed to explain the physical nature of magnetism. Beginning at this point, the author passes in review the work of Poisson; Faraday's conception of lines of force, with its necessary recognition of the part played by the medium; the successful development of this idea in mathematical form by Maxwell; the theories of Weber and Ewing; the experimental work of Curie on diamagnetic and feebly magnetic substances; and finally, the modern electronic theory of magnetism as extended by Langevin, Weiss, Gans, and others. The various stages in the historical development are clearly displayed, and, although more elementary in its treatment, the book is a worthy companion of Whittaker's well-known "History of the Theories of Elasticity and the Ether." An English volume of similar scope would be a very desirable addition to current text-books. R. S. W.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

The Theory of Radiation.

The natural unit of angular momentum postulated by Dr. Niels Bohr, of Copenhagen, in his researches on the theory of spectral lines actually exists. It is the angular momentum of the magneton. Rejecting entirely the idea of magnetic or electric substance, the magneton may be regarded as an inner limiting surface of the æther, formed like an anchor-ring. The tubes of electric induction which terminate on its surface give it an electric charge, the magnetic tubes linked through its aperture make it a permanent magnet.

I find that the angular momentum of any such system, whatever its shape or dimensions, about its axis of symmetry is $(8\pi^2 V)^{-1}\epsilon\mu$. V is the velocity of light, ϵ the electric induction over the surface, and μ the magnetic induction over the aperture. I shall consider elsewhere the applications to the theory of complete radiation, spectral series, and the asymmetrical emission of electrons in ultra-violet light. Only this need be mentioned. If an electron (charge ϵ) be thrown off from a magneton like a speck of dust from a flying wheel, then the angular momentum of the magneton changes by the amount $-1(2\pi V)^{-1}\mu$. This is therefore the angular momentum of the ejected electron about the axis of the magneton. Taking the velocity of ejection to be proportional to the angular velocity in the magneton, we have Ladenburg's result that the energy of the emitted rays varies as the frequency.

Dr. Bohr, by first insisting on the fact that Planck's h is an angular momentum, has done something of the greatest importance, whatever the ultimate fate of his particular interpretation. Dr. Nicholson has, I think, used the same idea.

G. B. McLaren.

University College, Reading, September 20.

Stability of Aëroplanes.

In his experiments on the resistance of the air to spheres, M. Eiffel showed that for a certain critical velocity for a given sphere the resistance suddenly fails. The critical velocity appears to be very different for different spheres; *e.g.* in his paper (*Comptes rendus*, December 30, 1912) the sudden change is shown to begin at velocities of 12, 7, and 4 metres per second for spheres of diameter 16·2, 24·4 and 33·0 cm. respectively.

Suppose we make a triangular frame with one of these spheres at each corner and allow the frame to fall from a height. It would appear that if the weights of the spheres were so adjusted that the frame would maintain a horizontal position for a part of its flight, it must reach some velocity at which the equilibrium of the resisting forces would be destroyed, and rotation would ensue, tending to make the frame take up a vertical position.

If such a law holds for bodies of other shapes than spheres, it would appear that an aëroplane would have a much better chance of being stable in winds of great variety of velocities, if the resisting surfaces were all of the same size and shape.

I do not know whether this case has already been dealt with by others, and I make the suggestion for what it may be worth.

G. A. Shakespear.

The University, Birmingham.

The Pancreatic Treatment of Tuberculosis and Malaria.

There are two points in Dr. Saleeby's remarks upon p. 61 of Nature (September 18, 1913) which I should like to notice briefly. In my letter to you on the same page I did not refer to Baetzner's brilliantly successful results in the treatment of tuberculosis by pancreatic enzymes (*The Practitioner*, January, 1913, pp. 203–219), because after his prolonged investigations the thing is *an accomplished fact*, which cannot be disputed by any interested in its operative treatment. I am neither a medical practitioner nor the apostle of a new faith, but merely a scientific investigator. I foresaw, and foretold, the complete success of this treatment of tuberculosis in 1907; and with the fulfilment of this scientific forecast at the hands of Dr. M. A. Cleaves in that year and of Dr. W. Baetzner more recently, my concern with the matter has ended. Moreover, I have taught medical students for more years than I care to think of, and I know how hopeless it is to try to teach something new of a scientific nature to the medical profession.

As to the *sexual phases* of the life-cycle in malaria, they are of no practical importance at all in the treatment of malaria by enzymes. A reference to Major Lamballe's original manuscript shows that the presence of such *sexual* phases had been verified in several of his cases. Like all the clinical symptoms, such as in grave cases, delirium and coma, these sexual phases vanished and did not return, when the Fairchild injections of trypsin and amylopsin were administered. These sexual phases, the so-called "crescents," have a scientific interest, but scarcely a clinical importance, as Major Lamballe also recognises. The disease is not continued by them any more than cancer is continued by the cells, to which Prof. Farmer gave the name of "gametoid tissue." Probably they are got rid of by the leucocytes, but, in any case, in ordinary circumstances the pancreatic ferments would be devoid of action upon such *sexual* phases, as my experiments upon various non-pathogenic micro-organisms demonstrated (*vide* Beard, J., on the occurrence of dextrorotatory albumins in organic nature, *Biol. Ctrlblatt.* vol. xxxiii., pp. 150–170, 1913). J. Beard.

8 Barnton Terrace, Edinburgh, October 1.

Relative Productivity of Farm Crops in Different Countries.

In view of the repeated statements that British farming is declining and that the world is threatened with a shortage of wheat supplies, the following extract from the results of an investigation into the facts regarding both these questions may be of interest. Lack of space precludes reference to the sources of information, the statement of the results for all countries, details as to the method of investigation, and so on, but the condensed tabular summary which follows is typical of the results as a whole:—

—		Wheat			Oats			Barley			Potatoes		
		(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)	(*a*)	(*b*)	(*c*)
United Kingdom	1.	1·4	3·4	2·4	4·2	6·9	1·6	5·0	9·4	1·9	5·3	6·8	1·3
	2.	1·0	2·3	2·4	3·9	6·0	1·6	3·9	7·3	1·9	4·0	4·9	1·2
	3.	0·7	1·7	2·4	3·4	5·0	1·5	2·6	4·7	1·8	3·4	4·5	1·3
France	1.	9·0	13·2	1·5	8·9	10·2	1·1	5·0	6·0	1·2	13·5	15·6	1·1
	2.	8·1	11·8	1·5	8·7	8·3	1·0	3·9	4·5	1·2	11·1	10·4	0·9
	3.	6·7	9·8	1·5	7·6	7·9	1·0	2·5	2·9	1·2	10·5	8·6	0·9
Russia	1.	15·7	10·7	0·7	34·3	22·0	0·6	25·8	16·3	0·6	14·2	8·3	0·6
	2.	17·2	11·6	0·7	33·0	22·4	0·7	30·9	21·0	0·7	24·6	16·4	0·7
	3.	19·6	14·3	0·7	32·3	22·8	0·7	30·0	21·7	0·7	28·0	19·7	0·7
United States ...	1.	19·3	18·7	1·0	22·6	24·8	1·1	5·6	7·0	1·3	9·2	5·0	0·5
	2.	20·5	21·6	1·0	24·0	2 ·7	1·0	5·5	6·8	1·2	8·9	4·7	0·5
	3.	19·6	20·4	1·0	24·1	25·1	1·0	8·1	10·3	1·3	8·9	5·5	0·6
		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
World changes in yield per acre ...		100	103	113	100	112	122	100	106	115	100	108	114

Decades—(1) = 1881–1890. (2) = 1891–1900. (3) = 1901–1910.
(*a*) Percentage of world's acreage. (*b*) Percentage of world's crop.
(*c*) Ratio of (*b*) to (*a*) = relative productivity per acre.

Column (*a*) gives the average percentage acreage for the three last decades, and column (*b*) the average percentage total crop; France is typical of the countries which have declined, and Russia of those which have improved under these heads. Column (*c*) measures relative productivity, which has been practically constant all the world over for the three decades. Information is added to show the increases which have taken place for the world as a whole in relative yield per acre.

The end of the nineteenth century may be considered as the close of a commercial revolution due to improved communications and transport, &c., and therefore the period under review is notably distinct from earlier epochs, so that the relative constancy of the productivity of these and other crops may be held to be a characteristic of this revolutionary period. Farming is a world business; improved results are common to all countries. The figures are instructive with reference to the threat of a world famine, *e.g.* if Russia only improved to the level of the United States, there would be an increase of 6 per cent. in the world's crop of wheat. At the same time it becomes obvious that the British farmer is the most successful farmer in the world; he always obtains a higher yield for each acre of land he tills. These are but the most important conclusions to which these results point; others may suggest themselves to your readers.

B. C. Wallis.

Granville Road, North Finchley, N.

The Elephant Trench at Dewlish—Was it Dug?

I was not aware that it had occurred to Mr. Clement Reid, before it had done so to me, whether the Elephant Trench might have been excavated by man. He does not refer to this in his survey memoir on the Dorchester district; and so far as I can recollect he did not mention it when I described the trench with lantern slides at the meeting of the British Association at Cambridge in 1904. He now states (Nature, Sept. 25) that he is convinced that the trench was due to *natural agencies*, and suggests that it was "probably wind-cut by the swirl of the fine dust-like quartz sand which, mixed with polished flints, now fills the lower part."

For my part I cannot imagine how such a trench could have been formed in that manner. He says that he found the sides of the trench "curiously smooth, and no tool marks nor rubbings such as might be made by man working in the trench, or by wild beasts," and also that the flint nodules projected into the cavity from either side as though the softer chalk had been scoured away. The fine sand which partially fills the trench is, I think, to all appearances wind-borne; and during the long interval which probably elapsed before the trench had become filled up by natural agencies the surface of its walls would have become weathered away, and, possibly abraded by the sand, leaving the courses of flints projecting, and completely obliterating any tool marks.

Mr. Reid remarks: "If this sand-filled fissure is found to continue downwards, but is too narrow for a man to work in, it will show that the trench is not artificial." On the other hand, my late lamented friend the Rev. R. Ashington Bullen wrote to the *Geological Magazine* (July, 1910, p. 334), describing a pitfall to catch antelopes. It was 10 ft. deep, 2 ft. wide at the top, narrowing at the bottom to a *few inches.*

I may, however, say that when I dug at the end of the trench on the hill-face I came to the conclusion that the bottom of the trench was a flat chalk surface, and near the bottom I found some angular coarse gravel, and among it a nearly worn-down molar along with the polished flints. If, as Mr. Reid suggests, the trench was excavated by wind, which appears to me impossible, all the flints corresponding to the chalk so removed ought to lie, now, unbroken at the bottom, but in my notebook I find the remark that the flints in this gravel did not appear to have come "from the chalk direct."

I am extremely glad that Mr. Reid's interesting reply to my letter shows that I have succeeded in directing the attention of geologists to this, as I believe, important question.

O. Fisher.

Graveley, Huntingdon, September 26.

Referring to Mr. Clement Reid's letter on the origin of the Elephant Trench at Dewlish, in Nature of September 25, on the Yorkshire wolds holes are not infrequently scooped out of the chalk by what are locally termed "cloudbursts." One such, 13 ft. deep, occurred in the parish of South Cave last year.

G. W. B. Macturk.

15 Bowlalley Lane, Hull, October 4.

A New Poet of Nature.

Readers of *The English Review* must be inured to shocks; but among the revolutionary visions which its young men have seen, surely nothing more startling has been recorded than this, which I extract from a short poem entitled "Early One Morning":—

"Have you heard what the young moon said to me
As I walked in the morning early?
. . . .
She lay on her back and laughed at me
As I walked in the morning early."

W. D. E.

TRAVEL IN TIBET.

(1) IN a third volume Dr. Sven Hedin concludes the popular account of his Tibetan expedition of 1905–8, of which the main instalment was published four years ago. The present volume collects "all the material for which there was no room" in the previous two tomes. This includes a description of the explorer's journey northwards from the Mānasarowar Lake to the source of the Indus, which Dr. Hedin was the first European actually to penetrate, and of the well-known route from that lake along the Sutlej Valley back to Simla. Added to this are miscellaneous extracts from the books of previous writers and travellers on a variety of Tibetan topics, also a polemical defence of the author's discovery of the "Trans-Himalaya," a claim which has been disputed by a writer in the *Geographical Journal*, on the ground that the existence of that range was undoubtedly known in a general way over a generation ago. The breezy, rollicking narrative reflects the abounding enthusiasm of the author, and couched largely in dialogue form it reads almost like a romance, conveying at times the impression of a holiday romp rather than a rigorous journey achieved only by the painful toil of man and beast.

Of the scientific results, "which will shortly be issued," it is mentioned that the geological specimens (1170 in number) have enabled Prof. A. Hennig, of Lund, to say that the older sedimentary rocks of the Trans-Himalaya generally resemble those found on the northern flanks of the Himalayas near Gyantse and Lhasa in Central Tibet. They consist of Jurassic quartzites and phyllitic schists, with subordinate beds of slaty crystalline limestone, which is so strongly metamorphosed that if it did originally contain fossil remains these are quite destroyed. The series is penetrated by an intrusive formation which has suffered metamorphosis by pressure, and therefore is older than the other. The eruptive formation is obviously part of that found in both the eastern and western Himalayas, and ascribed to the Eocene age, and consists in the Trans-Himalaya of intrusive granites, pegmatites, porphyries, &c., with vitrified surface lavas, basalts, and sub-aërial volcanic tuffa. It is noteworthy that the Brahmaputra Valley, which separates the Himalayas from the Trans-Himalaya, must be considered as "a deeply excavated *erosion*-valley, and that faults do not play the leading part here which Oswald has assigned to them in his article based on Dr. Sven Hedin's preliminary communications."

FIG. 1.—"I dangle between Heaven and the murderous Sutlej." From "Trans-Himalaya."

Some mistakes are noticeable in respect to the legends and etymologies of the names of the great rivers rising in the vicinity of Mount Kailas, the Hindu Olympus, and require emendation. They

[1] (1) "Trans-Himalaya: Discoveries and Adventures in Tibet." By Sven Hedin. Vol. iii. Pp. xv+426+plates+maps. (London: Macmillan and Co., Ltd., 1913.) Price 15s. net.

(2) "The Land of the Blue Poppy: Travels of a Naturalist in Eastern Tibet." By F. Kingdon Ward. Pp. xii+283+xxxix+plates+5 maps. (Cambridge University Press, 1913.) Price 12s. net.

are perhaps due to the indirect process made use of in interrogating the Tibetans, of which the author states "I spoke Jagatai Turkish with my men, and Rabsang translated for me into Tibetan." Thus, we read "Mānasarowar means 'Mīnasa the most beautiful of lakes.' Mānasa means 'created by the soul,' for the lake was created by the soul of Buddha." In this equation our author has evidently confused Brahmā with Buddha. For there is no authentic Buddhist legend associating Sakya Muni or his "soul" with the creation of this lake; indeed, that teacher as an elementary part of his doctrine denied the existence of a soul altogether. On the other hand, Brahmā in Hindu myth is often linked with this lake, doubtless because "*Mānasa*," meaning in Sanskrit "mental or spiritual," or "produced by the mind," is an epithet of Brahmā, and Kailas, the Olympian abode of the other gods created by Brahmā, adjoins this lake. To say that *sarowar* means "the most beautiful of lakes" is neither literally correct nor appropriate. No photograph of that lake is given in the present volume, but no one who has seen this desolate lake, as the writer of this note has, could think of calling it "most beautiful." The word really means "the great lake," or literally "the best or sacred lake," but with no sense whatever of "beautiful." Similarly, the Brahmaputra, the source of which is known to the Tibetans as "the river of the horse's mouth," is, we are told, "so named in honour of Buddha's steed," though, as a fact, neither Buddha nor his steed are denoted in this name, nor is there any authentic legend of such relationship current amongst Tibetans. Again, the statement that "'Singi-kamba' [='the lion's mouth'] the Indus, refers rather to the tiger than the lion," is a mistake, as "*Sing*" means only "lion," and not tiger; and lions are not even yet extinct in the mid-Indus valley, where they are believed to have been formerly generally distributed. The volume is enriched by numerous excellent photographs and sketches, which are admirably reproduced, and add greatly to the attractiveness of the book.

(2) Under the title of the "Land of the Blue Poppy," Mr. Ward, son of the late Professor of Botany at Cambridge, describes his travels on the Chinese border of Eastern Tibet, as a collector of decorative plants for a firm of florists. In this work he spent several months in 1911 in the upper valleys of the Yangtse, Mekong, and Salwin, with his headquarters at the missionary station of "A-tun-tsi" (the A-tun-tzu of the maps), on the north-west frontier of Yunnan. As a result he gathered many rare plants, including more than twenty new species, amongst which was the *Meconopsis*, named after him, and giving the title to his book; also two new voles. Although he displays no very intimate acquaintance with the writings of previous travellers in those regions, his narrative is pleasantly written, and contains some observations of general interest.

The extensive cultivation of opium-poppy, in "solid fields" and otherwise, which he noticed in Western Yunnan, is of political importance at the present time, when India is depriving herself of enormous revenue from opium solely in the interests of assisting China to stamp out the vice of opium-eating, and on the express condition that China herself ceased all cultivation of that drug. On one of the occasions on which Mr. Ward lost his way, and wandered alone for several days in the wilds, he ate a quantity of rhododendron corollas for their nectar, and was surprised to find them poisonous—forgetful of the toxic Pontine honey described by Xenophon, and usually ascribed to rhododendron or azalea. With the exception of *R. arboreum* the Himalayan species are generally regarded as poisonous.

Of the Tibetan character and hospitality he

Fig. 2.—The Salween Forests in Summer, Mekong-Salween Divide, 8,000 feet. From "The Land of the Blue Poppy."

speaks with much enthusiasm. In the dress of the Tibetan men he remarks as "very curious a section of an elephant's tusk threaded on to the queue"—this doubtless is the thumb-ring of the ancient bowmen, whose dress the modern Tibetan dandy imitates, and binds the ring on his coiled pigtail when not worn on the thumb on ceremonial occasions. Other border tribes of much ethnological interest amongst which he passed were Lissu, Lutzu, Minchia, "Lama," Pe-tzu, Chu-tzu, and Mosso. The last-named is of especial interest as possessing an elementary hieroglyphic writing, somewhat like that of the Hittite, the origin and development of which is still unsolved, though specimens have been published by Captain Gill, Prince Henri, and Mr. Forrest. Yet our author makes no reference to this matter. He encountered several hot-springs, but unfortunately took no record of the temperature, nor indicated their location exactly, as a guide to future travellers desirous of making precise scientific observations.

The oft-discussed question of the geological causation of that remarkable wrinkling of the surface of south-east Tibet into a series of parallel valleys, through which the great rivers rush southwards, is not advanced nearer to a solution by the vague theories indulged in in the last chapter. These hypotheses, which are not even new, are not based on examination of the actual rocks, and are uninformed by the many facts collected by the experts of the Indian Geological Survey and others. The great river of Central

Fig. 3.—The Salween in the arid region, below La-Kor-ah. From "The Land of the Blue Poppy."

Tibet is not usually spelt "Bramapootra" nowadays. Notwithstanding its scientific deficiencies as "the journal of a naturalist," the book gives a lively popular account of adventurous travel off the beaten tracks, and the numerous photographs convey a good idea of the country traversed.

THE OCCURRENCE OF OIL SHALE AMONG THE JURASSIC ROCKS OF RAASAY AND SKYE.[1]

THE Geological Survey of Great Britain in the course of their investigations in the Isle of Skye have discovered an oil-shale which may ultimately prove of economic importance, and as notices of the discovery have appeared in the daily Press, it is desirable that the facts so far as they are known to the Geological Survey should be placed on record without further delay. The discovery was made by Dr. G. W. Lee, who has written the following account:—

The stratigraphical position of the shale is at the very base of the Great Estuarine Series, a group which succeeded strata containing a fauna of Garantiana age (high in the Inferior Oolite),

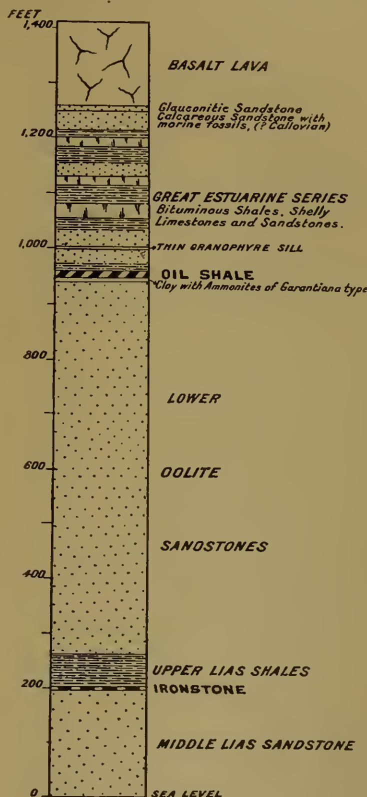


Diagram section illustrating the sequence of the Jurassic rocks below Dùn Caan, Isle of Raasay.

and is overlain by Kellaways Rock. The shale itself yields fossils. They include Entomostraca, a flattened lamellibranch, and plant remains. Since it rests immediately on the marine Garantiana clay, it follows that the incoming of estuarine conditions must have been a sudden one.

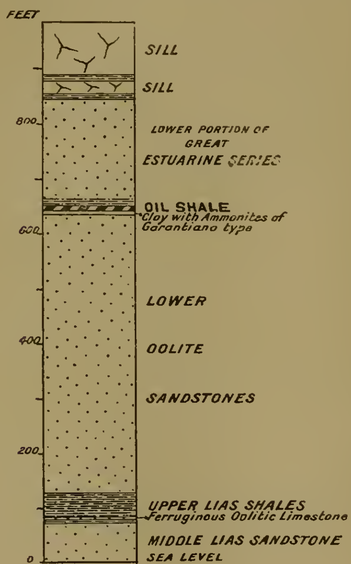
The shale is brownish in colour, fine in grain, gives a wooden sound under the hammer, and has a brown streak. It is tough and resists disintegration by weathering, a character which

[1] Communicated by the Director of the Geological Survey of Great Britain.

distinguishes it from the bituminous shales found throughout the Estuarine Series, all of which crumble into small fragments. It is so far known only from natural exposures, where through weathering, it assumes a lilac or yellowish coating.

The thickness of the seam at the outcrops may be taken to be from seven to ten feet, but its passage into the overlying sediments is gradual.

The samples so far analysed were much weathered, so that we are not yet in possession of exact data concerning the yield of oil and bye-products from the fresh shale. That the fresh shale might be expected to yield more than weathered portions seems probable, but to what



Diagrammatic section illustrating the sequence of the Jurassic rocks in the cliff between Holm and Prince Charles's Cave, Isle of Skye.

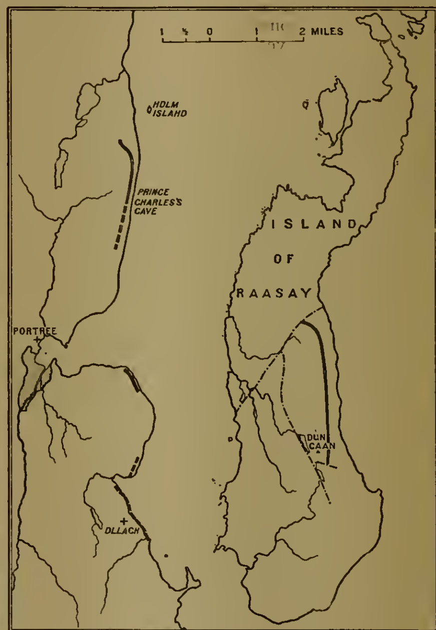
extent is not known, and it is on that that the industrial possibilities of the find depend.

A sample from the outcrop where the shale was first detected in Raasay gave 12 gallons of crude oil per ton of shale, with 6·2 lbs. of sulphate of ammonia, which is equivalent to at least 12 lbs. in a works retort.

A compound sample from the Skye coast between Holm and Prince Charles' Cave yielded 12·8 gallons of crude oil per ton, and 7·4 lbs. of sulphate of ammonia. Mr. D. R. Steuart, who kindly undertook these tests, states that the samples were so weathered that he did not expect to get any oil. Consequently these results indicate that the shale is worth further investigation.

Before the period of denudation which removed so much of the Scottish Jurassic rocks, the shale probably extended over a large area. Still, the portions that escaped denudation are not inconsiderable. In Raasay the field occupies an oblong area stretching from Dun Caan northwards to the boundary fault which throws the Mesozoic rocks against the Torridonian. It is three miles long, with an average width of seven-eighths of a mile, which diminishes southwards. The strata are not folded, but have a dip of about 10 degrees to the west.

In the Portree district of Skye there was once



Sketch map showing the outcrops of the Oil Shale.

——— Oil Shale.

– – – – Oil Shale, where burnt by contact action of igneous rocks.

—·—·– Faults.

an extensive field, of which much has been destroyed by the contact action of intrusive rocks. The crop has been traced from Ollach—five miles south of Portree—to the Holm burn—five miles north of Portree. The outcrop south of Portree shows much alteration from heat, except between the Tom cave and the Clach Dubh. North of Portree the destructive action of the intrusions is felt as far as Prince Charles' cave, but between that point and the Holm burn—one and a half miles further north—the shale has escaped the action of igneous rocks. There is no inland exposure of the oil shale horizon, which is everywhere covered by higher beds; consequently the probable extent of the field towards the west cannot be estimated. But the dip being low the shale would be within practicable reach for some distance inland. In the cliff section between Bearreraig and Upper Tote, that is north of the point just considered, the shale facies is replaced by a sandstone facies.

THE ADDRESSES AT THE MEDICAL SCHOOLS.

THE first of October is the opening day of the winter session of our medical schools; and in many of them it is made the occasion of an address, given by some person of high authority. The addresses this year include a wide range of subjects. Mr. Handley, at the Middlesex Hospital, gave a very pleasant discourse on the "renegades of medicine," the men who have forsaken medicine for some other profession, not without advantage to themselves and us—Keats, Goldsmith, Bridges, Huxley, Livingstone, and many more. It is a new subject, and worth working out; but we are not sure that Mr. Handley got hold of the right end of the moral. Sir William Osler at St. George's, Dr. Hunter at Charing Cross, and Prof. Sherrington at Leeds, spoke on certain problems of medical education. Sir John McFadyean, at the Royal Veterinary College, spoke on the working of the new Tuberculosis Order of the Board of Agriculture. He stated that the number of milking or dairy herds in England and Scotland free from tuberculosis was practically negligible; and he urgently advised the owners of valuable pedigree herds, as a matter of their own profit, to eradicate the disease among their animals. He also advised that contagious abortion in cows, and Johnes's disease, should be brought under the Contagious Diseases of Animals Act.

Two of the October addresses this year are of especial interest—one, at the London School of Medicine for Women, by Sir Charles Lukis, Director-General of the Indian Medical Service; the other, at St. Mary's, by Sir John Hewett, sometime Lieut.-Governor of the United Provinces. These two addresses, by men of profound experience and unquestioned authority, should be read carefully by all who want to know what the medical profession is accomplishing, and what it hopes to accomplish, for the peoples of India.

Sir Charles Lukis, speaking to women students, appealed to them for personal service. His appeal, full of wisdom and of sympathy, ought not to fail: for the work done in India by medical women is some of the very best work in the world. He spoke, especially, of the imperative need of more teaching and more acceptance of ordinary rules of sanitation, not only for the prevention of the spread of malaria, plague, and tuberculosis, but for the prevention of food-infection, and water-infection. It is our medical women who alone can get the women of India to help in this good work. "Ladies who have spent all their lives in England are apt to regard their Indian sisters as being very downtrodden and oppressed. This is a grave mistake. Out of doors the man is lord of creation, but once he is inside the house he is absolutely controlled by his wife and mother in all matters concerning domestic economy and the family life. Indeed, I know of no country where the woman is more absolutely the mistress of the house than she is in India; and I am convinced that we shall never make any real headway in promoting the knowledge of domestic and personal hygiene until we have convinced the women of India as to its necessity, and they have thrown their powerful influence into the scale. Here the medical man is useless—the *purdah* bars the way, and it is to the medical woman that we must look." Sir Charles Lukis went on to speak of infant mortality in India, and of its relation to early marriage, and to the native methods of midwifery. Then he described fully the improved scheme for a women's medical service for India, and the plan for a medical college for women to be established in Delhi. Every word of his address is worth reading.

So is every word of Sir John Hewett's address on the work of the medical profession in India. He spoke first of the improved health in the Army, and in the jail population. "The mortality among the wives of soldiers has been reduced to one-third of what it formerly was, and that among their children to one-half." The death-rate among the native troops has come down from more than 20 per thousand in 1871–1880 to less than 7 per thousand in 1911. The death-rate among the jail population has come down from 71 per thousand in 1831–1856 to 18 or 19 per thousand in 1911. Sir John Hewett then spoke, with strong feeling, of the errors of anti-vaccination and anti-vivisection. Truly, in view of the facts of India, they are worse than errors. "It is surely calamitous that the opponents of vaccination in England should have set themselves to make the people of India hostile to a process which has brought them so much benefit." To the anti-vivisectionist, we commend Sir John Hewett's statement of the results of the protective treatment against plague, typhoid, and hydrophobia in India. These results are not only a final verdict against anti-vivisection; they are a magnificent record of the saving of the lives of men, women, and children.

SCOTTISH ORNITHOLOGY IN 1912.[1]

THIS report supplies in an epitomised form the results of the activities of Scottish ornithologists during the past year. It is a comprehensive and well-arranged booklet of ninety-six pages, and is both useful and important, since it affords much information hitherto unpublished, as well as a *résumé* of all that has appeared in serial literature during the period covered. A pleasing feature is to be found in the fact that these well-known lady ornithologists have themselves contributed materially to the year's opera-

[1] Report on Scottish Ornithology in 1912, including Migration. By Leonora Jeffrey Rintoul and Evelyn V. Baxter, hon. members of the British Ornithologists' Union. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson. Price 1s 6*d*. net.

tions by their investigations made during a two months' residence in the lighthouse at the Isle of May—a famous bird observatory situated in the North Sea off the mouth of the Firth of Forth. There are also contributions from nearly one hundred observers, posted between the Muckle Flugga (the northernmost limit of the British Isles) and the shores of the Solway and Tweed. This vast amount of material has been arranged under the following headings: birds new to Scotland; uncommon visitors and species new to faunal areas; extension of breeding range; hybrids; summer and nesting; winter; ringing; plumage; food, habits, &c.; and migration.

Much that is interesting is recorded under all these headings, but the special feature of the report lies in the wealth of data from the numerous islands—the most important, in some respects, of all bird stations.

These insular records relate mainly to the spring and autumn passage-movements of those feathered voyagers which traverse our shores when *en route* between their accustomed northern summer haunts beyond our isles, and their winter retreats lying to the south of them. These birds form by far the most numerous class of migrants that visit the British area. At such stations, especially the northern stations, the comings and goings of these travellers are to be observed free from the complications that arise on the mainland through the presence of birds of the same species which are simply local natives or engaged in local movements. In addition, the recent attention devoted to island stations has resulted in the garnering of a remarkable crop of records on the occurrence of rare visitors, some of them mere waifs, while others formerly considered such have unexpectedly proved to be annual in their appearances—among others the yellow-browed warbler, red-spotted bluethroat, little bunting, ortolan bunting, and grey-headed wagtail.

The year 1912 was remarkable for the number of rare species detected at Scottish stations. These included the black chat, northern bullfinch, scarlet grosbeaks, little buntings, Richard's pipit, red-breasted flycatchers, Blyth's reed warblers, icterine warblers, barred warblers, snowy owl, Tengmalm's owl, broad-billed sandpiper, Temminck's stints, little bustard, &c., the visits of which are duly recorded along with the particulars relating to their occurrence.

In conclusion Scottish ornithologists have every reason to be satisfied with the results of the year's investigations and may congratulate themselves on the able and excellent manner in which these results are set forth in the report.

W. E. C.

NOTES.

A few days ago (October 2) the daily Press published sensational paragraphs to the effect that Sir Frederick Treves had announced, at the Radium Institute, "a complete revolution in the future of radium." When analysed, the "revolution" amounts to little more than a statement that the Radium Institute has begun to collect radium emanation in sealed glass tubes, and to issue the tubes to doctors for the treatment of their patients. It was assumed by the literary young men who write the leaders and notes in the daily papers that radium emanation had just been discovered instead of being known and named for ten years or more, so they let their enthusiasm overstep the bounds of their knowledge. Even the method referred to by Sir F. Treves is not new; it was published in *The Lancet* on December 11, 1909, p. 1742 ("On the Use of Radium for Local Application within the Body," by Dr. Alfred C. Jordan), and this paper is quoted and fully abstracted by Dr. Dawson Turner in his book on "Radium: its Physics and Therapeutics" (Baillière, Tindall and Cox, 1911), pp. 27 and 28. In *The Lancet* the glass tube containing the emanation was directed to be enclosed in a tube of lead "compo" of 1 mm. thickness, and this in its turn in a length of rubber tubing. Of course, these tubes must be used at once, for the emanation decays to one-half its initial strength in three and a half days. A tube of initial strength equal to 10 mg. of radium may be placed in contact with a tumour, and left to "decay" there. It will be understood that emanation used in this way (in sealed tubes surrounded by 1 mm. of lead) depends for its action on its γ rays and its hardest β rays, the glass stopping all the α radiation, while the lead absorbs most of the β rays. Very different is the action of free radium emanation, as in radio-active waters. In the latter case the α particles are able to bombard the tissues at close quarters; the action of the β and γ radiation then becomes negligible, possessing no more than one-hundredth part of the energy of the α radiation. Great care must be used in applying α radiation to the tissues, for the destructive action is most pronounced. Good results have been obtained with radium in many diseases, but the hopes of the public as well as the medical profession are centred round the treatment of cancer. Even in this dreaded disease many favourable results have been reported both with radium and with the Röntgen rays, but unfortunately disappointments are far more frequent than cures.

The year 1914 is the centenary of the birth of Sir John Lawes, and 1917 is that of Sir Henry Gilbert; and it is proposed by the Society for Extending the Rothamsted Experiments to raise the sum of 6000*l.* by public subscription for the purpose of erecting a suitable commemoration laboratory at the Rothamsted Experimental Station. It is understood that if 6000*l.* is raised in this way, a further grant of 6000*l.* can be obtained, making a total of 12,000*l.* altogether, for which sum an adequate building could be put up. The rapid development of agricultural chemistry and bacteriology, and particularly of the special branches associated with Rothamsted—the composition of crops and the study of the soil in relation to the plant—has necessitated further increases in the laboratory staff, and has attracted a number of voluntary workers. For all these more modern accommodation is required than can be obtained in the older part of the present buildings. The work of Lawes and Gilbert not only laid the foundations of agricultural chemistry as a science in this country, but did much to improve British agriculture and raise it to its present high level. It also played a great part in developing the artificial fertiliser industry, which has remained an essentially British industry and has now assumed vast dimensions. The whole country has gained enormously through the work of these two men. It is therefore felt that the appeal should be national, and several committees have been formed for the purpose. Men of science have many calls on them, but it is hoped, nevertheless, that the sympathy which everyone feels with the Rothamsted work will manifest itself by practical assistance towards its development. Subscriptions should be sent to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

It is with great regret that we record the disappearance of Dr. Rudolph Diesel from the G.E.R. steamer *Dresden* on her voyage from Antwerp to Harwich on the night of September 29; the circumstances are such as to leave no hope of his being alive. Dr. Diesel will be remembered as the inventor of the oil engine which bears his name. Born in Paris in 1858, of German parentage, his training included courses at the Augsburg technical schools and at the Munich Technical College. His first published description of the Diesel engine appeared in 1893; aided financially by Messrs. Krupp and others, the next few years were spent in arduous efforts to realise the principle of his engine in a commercially successful machine. The difficulties to be overcome were very great. In the earliest attempt, compression of the air was effected in the motor cylinder and the fuel injected direct. This engine exploded with its first charge and nearly killed the inventor. The modern Diesel engine compresses the air in the motor cylinder to a pressure above 400 lb. per square inch, during which process the air becomes hot enough to ignite the fuel. At the end of compression, the fuel is injected by means of a separate air supply at a pressure higher than that in the cylinder. Nothing of the nature of an explosion occurs in the cylinder; the oil burns as it is injected, and, as the piston is moving outwards at the same time, the pressure does not rise to any extent. The fuel consumption of these engines is remarkable, being roughly one-half of any other type of oil motor. Engines both of a two-stroke cycle and of a four-stroke cycle are now being developed by many firms both on the Continent and in Britain. In Dr. Diesel's opinion the two-stroke engine would probably be the standard type for marine purposes. Marine Diesel engines of very large power have not yet been constructed, but many important experiments in this direction are being made. Dr. Diesel's loss will be regretted by men of science on account of his efforts to interpret practically the Carnot ideal cycle, and by engineers on account of the immense strides which his untiring energy and indomitable pluck have made possible.

Sir William Christie, K.C.B., F.R.S., formerly Astronomer-Royal, has been elected Master of the Clockmakers' Company.

The death is announced, at fifty-four years of age, of Dr. W. Carnegie Brown, joint secretary of the Society of Tropical Medicine and Hygiene, and author of papers on malaria and diseases of the tropics.

It is announced in *The Athenaeum* that in consequence of the efforts of Dr. C. Holder and others, extending over many years, the Legislature of California has constituted the island of Santa Catalina a fish refuge. In future there will be no netting within three miles of the shore of the island.

The first ordinary meeting of the Medical Society of London for the session 1913–14 will be held on Monday next, October 13, when the new president, Sir David Ferrier, F.R.S., will deliver his inaugural address. The Lettsomian lectures of the society will be given on February 2 and 16 and March 2 by Dr. F. M. Sandwith, who will treat of the subject of dysentery.

According to *The Electrical Review*, a wireless receiving installation has been set up in the cathedral at Florence by the director of the Florence Observatory. All the parts of the equipment are within an enclosed space, the antennæ being within the building. Messages have been received from Paris, Toulon, and Madrid, the efficiency of the receivers being, it is stated, only slightly less than if in the open air.

A public meeting in connection with the ninth quinquennial festival of the Royal Albert Institution, Lancaster, will be held at Lancaster on Tuesday, October 21, when the following addresses will be given:—"The Feeble-minded: Historical Retrospect," Sir T. Clifford Allbutt, K.C.B., F.R.S.; "The Future of the Royal Albert Institution," Sir J. Crichton Browne, F.R.S.; "The After-care of the Feeble-minded," Dr. C. H. Bond.

The fourth exhibition of models, tools, and scientific apparatus, organised by the proprietors of *The Model Engineer*, will be held at the Royal Horticultural Hall, Westminster, S.W., on October 10–18. Special rooms are to be devoted to wireless telegraphy in operation, and to aëroplane models of all kinds, while a completely equipped workshop will be manned by members of the London Society of Model and Experimental Engineers, who will give demonstrations of model-making and workshop operations.

A conference of members of the Museums Association and others interested in similar work is to be held at the Warrington Museum on Thursday afternoon, October 30, for the purpose of discussing subjects of common interest to those concerned in the work of museums, art galleries, and kindred institutions. Offers of papers or suggestions of suitable subjects for discussion should be sent to Mr. C. Madeley, director of the Warrington Municipal Museum.

A demonstration of the results of his researches into the pathology of rabies will be given on Monday next to the Royal Society of Medicine by Dr. Hideyo Noguchi, of the Rockefeller Institute. Dr. Noguchi proposes to show pure cultures of various pathogenic and saprophytic spirochætæ; to demonstrate the presence of treponema pallidum in the brain in cases of general paralysis; to show experimental general paralysis in rabbits; and to give a demonstration of cultural studies of the virus of rabies.

IN response to numerous requests, it has been decided to defer until October 31 the closing of the Historical Medical Museum, referred to in our issue of July 3 (vol. xci., p. 456). During the month of October the exhibition will remain open from 10 a.m. to 6 p.m. daily, and from 10 a.m. to 1 p.m. on Saturdays. After this date it will be closed for a few months for re-arrangement as a permanent museum. It is proposed to reopen the museum in its permanent form in the spring of next year.

A MODERATELY strong earthquake was felt in the neighbourhood of the Panama Canal during the night of October 1–2, and has evidently caused some concern with regard to the safety of the canal from future shocks. It would seem, however, that there is little need for anxiety. Though other adjoining districts are frequently visited by destructive earthquakes, the isthmian zone itself is singularly free from such disturbances. Moreover, as Milne and Omori have shown, earthquake vibrations are much less intense in excavations than on the surface of the surrounding land.

IT is announced in *Science* that the Walker prizes in natural history of the Boston Society of Natural History for the present year have been awarded as follows:—The first prize of 100 dollars to Dr. R. A. Spaeth for a paper on an experimental study concerning the chromatophores of fishes, and the second of 50 dollars to Prof. O. D. von Engeln for a paper on the effects of continental glaciation on agriculture. Prizes for 1914 and 1915 will be awarded for original and unpublished research work in any biological or geological subject. Competing essays must reach the secretary of the society on or before April 1 next.

MAJOR BARRETT-HAMILTON, accompanied by Mr. Stammwitz, one of the taxidermists on the staff of the British Museum (Nat. Hist.), sailed in a whaler on Saturday last for South Georgia, on a mission from the Colonial Office, to report on the whaling stations leased by the British Government to a Norwegian firm. The species hunted at the South Georgian stations are chiefly rorquals, of which the slaughter is reported to be very heavy; and we understand that the main object of the mission is to ascertain whether the whales stand in danger of extermination. The taxidermist will endeavour to obtain specimens (not, of course, entire whales) for the museum.

MR. ALVIN LANGDON COBURN's exhibition of camera pictures, which is to be seen at the Goupil Gallery, 5 Regent Street, until October 25, is well worth a visit from anyone interested in artistic photography. The series of pictures of the Grand Canyon exhibit this remarkable region in a new light. Mr. Coburn's photographs, all enlargements from quarter-plate negatives, are as far apart from Hayden's well-known topographical drawings as could well be imagined; the latter faithfully delineate the grandeur of the vast spaces and lofty walls of the great valley by delicacy and accuracy of line and by their panoramic outlook. Mr. Coburn, limited by his apparatus to a smaller field, conveys the same sensations of vastness by his artistic use of atmosphere and the great shadows cast by hill and cloud. Clouds indeed are made the most of in all these pictures, and No. 44, "The Cloudburst," is not only a striking photograph, but a valuable record of this phenomenon.

AT the recent International Congress of Pharmacy held at the Hague, a proposal to form an international pharmacopœial bureau was discussed, and a commission was appointed to consider the question, and to submit to the International Pharmaceutical Federation at an early date a scheme for the establishment of such a bureau. The commission is composed of seven members, representing respectively Great Britain, the United States, Germany, France, Holland, Belgium, and Switzerland; most of the members are associated with the revision of their national pharmacopœias, the English representative being Prof. H. G. Greenish, joint editor of the "British Pharmacopœia," and the American, Prof. J. P. Remington, editor of the "United States Pharmacopœia." As the outcome of the deliberations of such a strong committee, a useful plan may be expected. Among the duties of such a bureau as that proposed would be the collection and examination of all literature relating to pharmacopœial revision and the experimental investigation of new drugs and preparations, and no doubt the influence of the bureau would tend to encourage the work already commenced in the direction of the unification of pharmacopœias.

The South African Journal of Science for September, being the organ of the South African Association for the Advancement of Science, reports the business proceedings of the meeting of the association held at Lourenço Marques in July last, under the presidency of Dr. A. W. Roberts. The following officers were elected for 1913–14:—President, Prof. R. Marloth; vice-presidents, Prof. L. Crawford, Mr. S. Evans, Dr. W. Johnson, and Mr. A. F. Williams; general secretaries, Dr. C. F. Juritz and Mr. H. E. Wood; general treasurer, Mr. A. Walsh. Invitations to hold the next annual meeting were received from the mayors and councils of both Kimberley and Pretoria; and the final decision as to the place was left to the council. A resolution was passed "that the Government of the Union be asked to pass legislation declaring that meteorites are Government property, and when found should be delivered to the nearest magistrate, for transmission to the nearest museum under Government control." The sixth award of the South Africa Medal, together with a grant of 50*l.*, was made to Dr. A. W. Rogers, assistant director of the Geological Survey of the Union, in recognition of his geological work in the Cape Province. In connection with the grant of 100*l.* made to Dr. A. W. Roberts by the association in 1905 for the reduction of his variable star observations, Dr. Roberts reported that he has had the observations, some 60,000 in number, reduced, copied in dulplicate, and indexed. The question of printing has, however, been a difficulty.

THE Board of Agriculture and Fisheries has issued a "Horses (Importation and Transit) Order of 1913" in accordance with powers conferred by the Diseases of Animals Acts, 1894 to 1911. The Order came into force on October 1; it provides for the proper accommodation of horses, asses, and mules on all vessels on which such animals are carried to or from any port in Great Britain, and for the proper construction of railway trucks used for conveying such animals in Great Britain. Provision is made for the proper feeding and watering at places of unloading and during transit. It is made illegal to convey any horse, ass, or mule by boat or train if, in the opinion of an inspector of the Board and notified by him, the animal cannot, owing to infirmity, illness, injury, fatigue, or any other cause, be so carried without unnecessary suffering. The above regulations, together with instructions as to disinfection, &c., have all been provided for by previous Orders, which have been revoked and re-enacted in the present Order. The principal reason for the present Order is to provide the following most necessary amendment, namely, that horses, asses, and mules brought to Great Britain from abroad are required henceforth to be accompanied by a veterinary certificate of freedom from symptoms of glanders (including farcy), epizootic lymphangitis, ulcerative lymphangitis, dourine, horse-pox, sarcoptic mange, psoroptic mange, influenza, ringworm, or strangles, instead of as heretofore from symptoms of glanders (including farcy) only.

WE have to acknowledge the receipt of a copy of a pamphlet issued by the Department of Lands and Survey, Victoria, on various methods of destroying rabbits and other "vermin" employed in that colony, and also containing the regulations with regard to fences of wire-netting.

THE National Equine Defence League has issued a fourth edition of a pamphlet on docking and nicking horses. The fact that Parliament has passed a law, to come into operation on January 1, 1915, making the practice of "docking" horses illegal, and that the purchase of docked remounts for the army is to be discontinued as soon as practicable, seems to render the pamphlet somewhat superfluous—at any rate, in this country.

WE have been favoured with an extract from *Neue Weltanschauung* for 1913, Heft 913 (pp. 321–332), in which Dr. W. Breitenbuch directs attention to the fact that the present year is the jubilee (fiftieth year) of Prof. Ernst Haeckel's work on evolution. The article includes a chronological account of the learned professor's studies during that long period, with brief notes on the numerous memoirs and works which have made his name famous.

To the series of biographical memoirs issued by the National Academy of Sciences, Washington, Prof. H. F. Osborn has contributed an exceedingly interesting account of the life and work of Prof. Joseph Leidy, the founder of vertebrate palæontology in America, and the last great naturalist of the type who made the entire subject of zoology their study, and published papers and works of permanent value in almost every branch. That such encyclopædic knowledge and broad grasp of the whole field of natural history can, as his biographer remarks, never reappear, is a matter for regret, as the specialised lines on which zoology is now, from necessity, studied cannot fail, in many cases at any rate, to result in narrowness of view. Although his study of the rhizopods was sufficient of itself to establish a great reputation, Leidy will chiefly be remembered as a palæontologist, and especially by his descriptions of Poëbrotherium and the so-called oreodonts, or "ruminating hogs," which paved the way for the discovery of the phylogeny of the camels and other artiodactyle ungulates.

To vol. vii., part 2, of *Annotationes Zoologicae Japonenses* Mr. B. Aoki contributes a list of Japanese and Formosan mammals. The island of Saghalien is also stated to come within the scope of the list, but no mention is made in the introduction that Korea is likewise included, although in the text we find (p. 272) a Korean shrew. On the other hand, Korea is not in the range of the tiger (p. 312), although the animal abounds in that country. The total number of forms, inclusive of subspecies, is 197. If trustworthy, the identification of three foxes with American, rather than with Asiatic or European, races is of considerable interest; but it may be noted that one of these races—the black or silver fox (*Vulpes pennsylvanicus argentatus*)—is not recognised as such in Mr. G. S. Miller's list of North American mammals (1912). In a footnote on p. 317 "Arctocyonidæ" should be "Arctoidea + Cynoidea." Mammals collected in Korea form the subject of an article by Messrs. Allen and Andrews in Bull. Amer. Mus. Nat. Hist., vol. xxxii. (pp. 427–36). In connection with the above may be noted a paper by Messrs. Jordan and Thompson on fishes from the island of Shikoku, Japan, published as No. 2011 of the Proceedings of the U.S. National Museum.

THE Proceedings of the South London Entomological and Natural History Society for the past year contain matter of much interest, and give proof of continued activity on the part of the members of this well-known association of naturalists. Mr. A. E. Tonge's presidential address, delivered at the beginning of the present year, includes some excellent observations on the external characters of British lepidopterous ova. Mr. R. Adkin's communication on the subject of varietal names is marked by strong common sense, and the same may be said of his paper on the labelling of entomological specimens—a matter that was often neglected by the naturalists of a former generation, to the detriment of many results of their labours. Mr. A. E. Gibbs's paper on the genus Cœnonympha gave occasion for some interesting exhibits of the local variation to which species of that genus are subject. A useful account, well illustrated by photographs and drawings, of the British species of Forficulodea is contributed by Mr. W. J. Lucas. Perhaps the most important of the papers printed *in extenso* is Mr. C. J. Gahan's excellent memoir on mimicry in the Coleoptera. The author is a well-known authority on this order, and the great extent of his special knowledge enables him to treat the subject in a comprehensive and convincing manner. It is noteworthy to find that he considers it "hopeless to try to explain the facts of mimicry in any other way than as the result of natural selection." The reports of the field excursions and the discussions held at the meetings contain some valuable records, and the volume as a whole furnishes good evidence of the excellent work that may be done by local societies, such as the present, in encouraging an intelligent interest in the objects of natural history.

Petermann's Mitteilungen for September contains a characteristic portrait of the late Prof. H. Credner, the well-known geologist of Leipzig. Dr. K. Andrée discusses the important question of the correlation of sedimentary rocks with conditions of deposition, as a guide in the formation of palæogeographic maps.

Mr. C. A. Cotton, of Wellington, N.Z., publishes a paper on the physiography of the Middle Clarence Valley, New Zealand (*Geographical Journal*, vol. xlii., p. 225), in which the influence of Prof. W. M. Davis is apparent in the lucid illustrations of local earth-structure and surface features. The author contests Park's view that an ice-sheet passed across the district, which lies in the north-east of the south island.

Messrs. W. Hanns, A. Rühl, H. Spethmann, and H. Waldbaur, who accompanied Prof. W. M. Davis on a European tour in 1912, have published "Eine geographische Studienreise durch das westliche Europa" (Leipzig: Teubner, price 2.40 marks), a brochure which should well illustrate modern methods of investigation. The regions selected include Snowdonia, Cornwall, central France, and the famous Kirchet of Meiringen.

The Journal of the Meteorological Society of Japan for May contains, *inter alia*, a useful article on the amount of evaporation of water, by Mr. Y. Horiguti, in which he gives some results of his investigation of the subject with a circular atmometer 8 in. in diameter, 4 in. in depth, and a small layer of water, the instrument being freely exposed to wind and sunshine. The determination of evaporation is a very uncertain operation, and in a recent essay (Strachan, "Basis of Evaporation") it is noted that the methods hitherto tried with tanks have been more or less failures, although, with the assistance of theory, better results ought eventually to be obtained. Many formulæ by well known men of science already exist, and Mr. Horiguti has added another to the number. The result of his investigations shows that his formula, together with others referred to, will fairly well represent evaporation in the shade, but that in the open air this is not the case. He concludes that "there remains an ample space for further studies."

In 1881 a MS. known as the Bakhshâli, from a village of that name in the Peshawar district, was discovered. If the view of Dr. Hoernle be accepted, that it belongs to the third or fourth century A.D., it would be of unique value as pushing back the mathematical knowledge of the Hindus to a date much earlier than has hitherto been admitted. The question of date has been reopened by Mr. G. R. Kaye in vol. viii., No. 9, of the Proceedings Asiatic Society of Bengal for 1912. After a careful review of its contents he arrives at the conclusion that it is later than the time of Brahmagupta, or even later than Bhâskara. "The literary form and the mathematical form of the manuscript point to a comparatively late period; the script is not ancient; the notation used and the rules and examples have nothing ancient about them, and my general conclusion is that the manuscript was not written much before the twelfth century A.D. It may have been an adaptation of a more ancient work, but it is certainly not a faithful copy of any work composed much before the twelfth century." It will be interesting to await Dr. Hoernle's reply to this communication.

In the Proceedings of the Tokyo Mathematico-Physical Society (2), vii., 5, Mr. S. Yokota gives an analytical solution of the stress distribution in a riveted plate due to a simple push applied to a rivet, the surfaces being smooth. The lines of principal stress are plotted.

In addition to the usual lists of students and degree proceedings, the Johns Hopkins University Circular contains interesting mathematical notes edited by Prof. Frank Morley. Mr. J. E. Rowe, in a note on Fermat's classical theorem, shows that the sum of two powers of integers cannot be the same power of another integer (excluding, of course, the case of second powers) unless the index is greater than 100 and the largest integer greater than the twenty-ninth power of 10; and further, considering next the two types in which the greatest integer is odd or even respectively, the author says, "Also it is shown that one-half of all possible solutions of each of the two types just described are impossible" (!). In a note on self-dual rational quartics, Mr. L. E. Wear shows that the only quartic curves which reciprocate into themselves are the limaçon and the obvious case of two conics.

Prof. E. B. Wilson, writing in the July Bulletin of the American Mathematical Society on the unification of vector notations, expresses a doubt whether the several steps which have been taken in this direction recently have been steps "backward or forward, sideways or up in the air." The committee appointed at Rome in 1908 has not yet presented a report, so that not much of a step in any direction can be attributed to it. There has been great activity in the use of vector methods in Italy, which has served to stereotype the notations of Burali-Forti and Marcolongo, which differ from those in vogue in Germany and America. A valuable report by the late Dr. Macfarlane has been published in the Bulletin of the International Association for Promoting the Study of Quaternions and Allied Systems of Mathematics for June, 1912, and Prof. Wilson hopes "that the place of publication may not prove a burial ground for the essay." Lastly, Langevin's article in the French Mathematical Encyclopædia proposes a system of notations in which vectors are distinguished by interlineal superscripts, no special founts being used, and this seems likely to be widely adopted in France.

In the *Journal de Physique* for August, M. A. Henry, physics master at the Reims Lycée, describes how he has applied a well known form of micromanometer to make measurements in a number of directions in which a manometer is not often utilised. The manometer consists of a U tube with wide limbs joined by a horizontal capillary tube. The limbs are about half-filled with carbon tetrachloride, and the capillary contains a small bubble of air Any slight difference of pressure at the ends of the capillary produces a considerable motion of the bubble. The instrument is calibrated by tilting the tube support by means of a screw at one end. M. Henry shows how the instrument may be used to measure the excess of pressure in a soap-bubble and the effect of charging the bubble electrically, a small volume, a mass of a few grams, the density of a gas or of a solid, small amounts of heat, specific inductive capacity, difference of potential, a flow of gas, and the pressure exerted by a sound-wave.

The determination of sulphur in illuminating gas is the subject of Technologic Paper No. 20 of the Bureau of Standards, by R. S. McBride and E. R. Weaver, issued by the Department of Commerce, Washington. Experiments were made with the gas referees' apparatus and the apparatus designed by Elliot, Hinman-Jenkins, Drehschmidt and Somerville. The results of a series of comparisons are given, in which many variations were made to determine the best conditions of operation and the sources of error. The referees' apparatus appears to be most used in America as well as here, and possesses the advantages of simplicity and convenience; the accuracy obtainable with this, as with other forms, has been often over-estimated. The concluding portion of the pamphlet deals with the estimation of the sulphate in the liquid condensate, and details are given of the gravimetric determination, a rapid turbidimetric method, and a volumetric method based on that due to Holliger. Although most gas companies in this country are now free from any restriction as to the amount of sulphur present in their gas other than sulphuretted hydrogen, the pamphlet will be very useful to any chemists having to deal with this problem.

In the *Bulletin de la Société d'Encouragment* (No. 6, p. 805) Prof. Camille Matignon discusses in an interesting paper some of the less known recent processes for the industrial fixation of atmospheric nitrogen. The well known methods utilising an electric flame are only briefly touched upon, but especial reference is made to Schloesing's process of absorbing the nitrous gas so obtained with lime at a temperature of 300°. The principal processes dealt with are those of Haber, in which nitrogen and hydrogen are made to combine directly under the influence of a catalytic agent, and that of Serpek based on the formation of aluminium nitride by heating a mixture of alumina and carbon in a current of pure nitrogen at a temperature of 1800°. The latter method has a particularly bright industrial outlook owing to the fact that by decomposing the nitride with dilute alkali not only is ammonia obtained, but it is possible by means of it to transform bauxite into alumina suitable for the aluminium industry at a much reduced cost. The action between the alumina and carbon is effected in revolving cylinders, which are lined with aluminium nitride itself, as being the only sufficiently refractory material which will withstand the high temperatures employed.

Red Book No. 182 of the British Fire Prevention Committee contains an account of tests on three window openings filled in with Luxfer electro-glazing. The record gives the effect of a fire of ninety minutes' duration, the temperature reaching 1500° F. and not exceeding 1650° F., followed by the application of water for two minutes on the fire side. This test again indicates that forms of special glazing are being produced commercially that can serve most efficiently to stop the spread of a fire of considerable severity. It is the second occasion upon which "lights" presented for test by the British Luxfer Prism Syndicate, Ltd., have met the strain of a ninety minutes' test at temperatures exceeding 1500° F. Red Book No. 183 contains records of tests on two steel-cased reinforced concrete doors by Messrs. Chubb and Sons, one hung on runners and made to slide, the other hung on hinges, fixed in a reveal. The latter door secured "full protection" (Class B). The partially successful efforts to produce a single door able to do the work of two iron doors required under the London Building Act are of considerable technical importance. The radiation through the doors was very small. Doubtless the problem of making a sliding door flame-proof around the edges will be overcome.

OUR ASTRONOMICAL COLUMN.

A New Comet.—A Reuter message from Perth, W.A., dated October 7, reports that a faint new comet has been observed in the position R.A. 2h. 31m.; Dec. 3° 48′ N.

The Return of Westphal's Comet.—The identification of Mr. Delaran's comet with Westphal's comet of 1852 is now complete, its positions being in accord with those predicted on the assumption of the object being the return of the comet of Westphal.

The following ephemeris for the current week is given by Prof. H. Kobold in a Supplement to the *Astronomische Nachrichten*, No. 4684:—

12h. M.T. Berlin.

	R.A. h. m. s.	Dec. ° ′	Mag.
Oct. 9	21 16 24	+ 8 18·2	8·4
10	13 52	9 7·9	
11	11 25	9 57·1	
12	9 2	10 45·6	8·4
13	6 44	11 33·8	
14	4 32	12 21·3	
15	2 25	13 8·3	
16	21 0 24	+13 54·8	8·4

After observations on September 28, the corrections to the above ephemeris are as follows:—R.A. −34s., Dec. +9·9′.

As this comet does not reach perihelion until November 26, and as it is slowly approaching the earth, its brightness will be increased. In appearance the nucleus is described as well defined but elongated, and surrounded by a nebulosity 20′ in diameter. The tail has been observed to be 1·2° in length, while a photograph taken of it at Bothkamp on September 28 records a tail 3·5° long.

The comet is in a good position for observation in the evening, and its movement northwards will make the conditions more favourable. It is at present passing through the constellations of Equuleus and Delphinus, but later will reach Vulpecula and Cygnus.

In *The Times* of October 2 we read that Westphal's comet is the fourth member of the Neptune group of comets that has been observed at a second apparition, the others being those of Halley, Olbers, and Pons. Two other members of the group appeared in 1846 and 1847, and are expected back about 1921 and 1927. Westphal's comet has much the shortest period (61·118 years) of any member of the group, its aphelion being at almost exactly the same distance from the sun as the orbit of Neptune.

Photographic Study of the Solar Photosphere.—In an abstract from the Annals of the Observatory of Zô-sé (Tome iii., 1912), M. S. Chevalier, S.J., describes the results of his research on the solar photosphere as studied photographically. He first of all describes the early observations of the solar surface by Sir W. Herschel, and rapidly surveys those who followed him, concluding with the photographic researches of M. Janssen at Meudon. M. Chevalier points out that on these latter photographs the famous granules observed by Secchi, Dawes, &c., were recorded.

He then directs attention to the possibility of errors creeping in when photography is employed. Is the image recorded on the photographic plate necessarily a faithful representation of the object photographed? M. Chevalier says it is not, and in the present investigation he attempts to show that the *réseau photosphérique* discovered on Janssen's clichés is not solar. The phenomenon, he says, is chiefly due to deviations undergone by the luminous rays refracted in an abnormal manner. This abnormal refraction takes place in the interior of the telescope, and more especially in the neighbourhood of the secondary magnifier. M. Chevalier accompanies his memoir with a series of fine reproductions from photographs of the solar surface which he has taken to demonstrate his views, and it is by an examination of these that his conclusions must be studied.

Statistics of Nebulæ and Clusters.—In the *Arkiv för Matematik, Astronomi och Fysik* (Band 9, No. 15), Prof. C. V. L. Charlier has published a preliminary paper on the statistics of nebulæ and clusters. This contribution is part of the work of the Lund Observatory, which has undertaken a discussion of the position of the nebulous stars in space, and these statistics form a preliminary part of the investigation. In this publication Prof. Charlier represents both in statistical and graphical form, the information collected on card catalogues of the coordinates, brightness, size, and form of nebulæ, as well as other observations of interest. The base of the card catalogues was the three great catalogues of Dreyer. In these pages the results are given purposely without any discussion regarding their bearing upon the question of the distribution of the nebulæ in space. He remarks, however, that while in many respects they speak for themselves, in others conclusions must be drawn with great caution. The main interest here are the relations between the Milky Way and the positions and numbers of the nebulæ.

When it is remembered that distinction is made between five different classes of nebulous objects, namely, clusters, globular clusters, planetary nebulæ, annular nebulæ, and nebulæ, and that the objects number 13,223, some idea of the work involved in the investigation will be gathered.

Spectroheliographic Results from Meudon.—A memoir by MM. H. Deslandres and L. d'Azambuja, appearing in No. 9 of the *Comptes rendus* of the Paris Academy of Sciences, contains an interesting historical survey of the spectroheliographic work carried out at Meudon. The paper is more especially concerned with the *qualitative* results obtained by examination of the spectroheliograms secured since 1908, when the spectroheliograph of high dispersion was erected. Whilst careful to point out that the evidence does not permit the formulation of general laws, the authors are content to state that during the period in question the "filaments" (dark and definite stream-like markings seen in hydrogen and calcium light) have followed, but with a distinct lag, more pronounced in the case of the polar disturbances, the sun-spot variations. In this regard the polar disturbances recall the secondary maximum of high-latitude prominences. On the other hand, the "alignments" (markings somewhat less dark and sharp seen only in calcium light) have been without noticeable variations.

AN EXHIBITION OF PROGRESS IN LIGHTING AND HEATING BY COAL GAS.

THE National Gas Exhibition at Shepherd's Bush, which will be open during the whole of October, affords the best object lesson in gas lighting that the public has ever had the opportunity of studying, and the fascination is greatly increased by the absence of competing stalls, the exhibits being shown in model rooms, shops, studios, &c., under all the conditions in which they are likely to be used in practice.

It is something of an achievement to have induced the leading gas undertakings, municipal and private, and the leading manufacturers of gas appliances in the United Kingdom, to sink their individuality and rivalry and to cooperate in a coherent exhibition of the varied uses to which gas can be efficiently and profitably applied. The result should be of benefit both to the industry and to the public generally.

The exhibition impresses one with the enormous strides that have been made during the last few years in the application of gas for manufacturing, domestic, and public purposes. The introduction of vertical retorts, improved methods of purification, and the resulting greater yield of gas, coke, and by-products obtained from the coal carbonised, have resulted in its price being kept down in spite of the gradual rise in the cost of coal, whilst the enormous progress that has been made in the methods employed in its combustion has popularised it to an extent that could hardly have been foreseen a few years ago.

There is not the least doubt but that the introduction of the atmospheric burner and the incandescent mantle has been the real factor which has made gas the most important fuel for both heating and lighting, and in the present exhibition the progress that has been made from the inception of the union jet by Nielson in 1820, which gave less than one candle per cubic foot of gas consumed, to the modern high-pressure incandescent burner, with its sixty candles per cubic foot of gas, is demonstrated in a striking manner.

Various apparatus for raising gas to the pressure of several pounds per square inch, necessary in high-pressure lighting, is to be seen at work in the Industrial Hall, and the bearing which the high-pressure distribution has upon commercial applications is shown by the exhibition of a number of furnaces for a multiplicity of purposes, such as melting metals and hardening steel. In these cases it is necessary to concentrate the temperature over a defined area, and by increasing the pressure at which the gas is supplied very high temperatures under perfect control can be attained. Specimens of these different types of furnaces are also to be seen in other sections of the exhibition.

In domestic heating the grasping of the conditions necessary to make gas a hygienic domestic fuel has been the great factor that has led to progress. In the early days of the gas fire, only 25 to 33 per cent. of the heat was given out as radiant heat, and convection was relied upon largely to give the heating effect, this giving hot air to breathe, and at the same time leaving the objects in the room often so far below the body temperature as to lead to chill; whilst the capacity for moisture of the heated air caused a degree of discomfort that led to prejudice being raised against this method of warming living-rooms.

When, however, it was realised that a stove to be hygienic must always give a larger amount of radiant heat than of convected heat, advance was at once made, and the severe competition in which, in the last three years, the different makers of gas fires have indulged has resulted in the production of gas stoves which give a high radiant efficiency. Further advances are being made constantly, and it is anticipated that in a short time the percentage of radiant heat given by gas fires will be more than double that which was possible even three years ago. Meantime, the claim that there are gas fires in the exhibition which can transmit 50 per cent. of the heat energy into the room in the form of radiant heat is undoubtedly true, whilst in one case as high as 70 per cent. is claimed. Apparently there is no exhibit of Prof. Bone's interesting "flameless combustion" stove, which would have proved very attractive, but the steam used in the kitchens is generated by a Bonecourt boiler, which is a modification of the same principle.

A very fine collection of products from tar and ammonia liquor are shown in the shops that serve to illustrate the best methods of show-window lighting. These are divided into three classes, tar, ammonia, and cyanogen products, the first class especially being worthy of attention.

Another very suggestive exhibit is a series of compartments illustrating the effect of the colour and surface of wall-papers on the amount of illumination obtained from equal sources of light. Some valuable conferences have been arranged to take place during the period that the exhibition remains open, and especial interest will be felt in the promised discussion on the sanitary influence of gas lighting and heating, whilst the influence of gas as a fuel on smoke abatement will also receive its due share of attention.

CARNEGIE SCHOLARSHIP MEMOIRS.

Vol. v. of the Carnegie Scholarship Memoirs has just been issued by the Iron and Steel Institute. The volume contains six papers which differ very widely in merit and interest, but on the whole it represents a considerable amount of important research work. It is unfortunate, however, that the practice of publishing these papers in a separate volume tends to relegate them to oblivion, and at all events robs them of the advantages of discussion even by correspondence, thus lessening materially the value of the work done under the Carnegie scheme.

The preservation of iron is dealt with by Dr. Newton Friend; his results, if confirmed by future practical experience, are of considerable importance. He finds that the addition of small quantities of paraffin wax to paint lessens very materially corrosion in iron and steel merely exposed to the air, but rather assists corrosion in the case of plates actually immersed in water. Increasing the number of coats of paint beyond two also appears not only to offer no increased protection, but actually to promote corrosion. This result leads one to inquire whether the constant repainting of iron-work often practised on ships may not actually do more harm than good; at all events, an examination of some of these thickly painted surfaces should afford interesting evidence on the point. Finally, Dr. Friend finds that painting over a slightly rusted surface, from which, however, all lumps of scale, dirt, &c., have been removed, is actually more effective as against further rusting than the same paint applied to a completely cleaned surface—the only advantage of thoroughly cleaning the iron before painting lying in a better surface finish of the painted work.

Another paper of special interest is that by Mr. J. A. Pickard dealing with the determination of oxygen in steel. This is a question of steadily increasing importance, and the older methods are known to be quite unsatisfactory. Mr. Pickard's method consists in heating the drillings to be analysed in an atmosphere of hydrogen which is simultaneously kept in contact with phosphorus pentoxide, so that the concentration of water-vapour always remains very low. His results indicate a very satisfactory degree of accuracy, and the further application of his method will be awaited with interest.

A lengthy paper by Mr. A. Kessner deals with the development of the drill test for ascertaining the machining properties of steel; the author, working at Charlottenburg, has developed a form of apparatus whereby the rate of cutting under standard conditions can be measured with a considerable degree of accuracy, and has used this to study the effect of several factors upon the machining properties of metals and to compare the ball-hardness and tensile properties of materials with their machining properties. That ball-hardness is not a guide to machining properties is a result which might have been anticipated, but whether the author's form of drill test does not depend upon the measurement of a quantity which depends upon too large and complicated a system of factors yet remains to be proved.

Of the more theoretical papers, that of Mr. Humfrey, dealing with the influence of the intercrystalline cohesion of metals upon their mechanical properties is perhaps the most interesting. It is another step in the development of our conceptions of the internal mechanical constitution of metals, and although to some extent speculative, it is certainly suggestive, particularly as it offers the first attempt at explaining the mechanism of the effects of mechanical overstrain, which, while it raises the elastic limit in tension, and thus apparently hardens the metal, at the same time lowers the elastic limit in compression. Humfrey explains this by the development of severe internal stresses residing in the amorphous matter at the intercrystalline boundaries, these stresses tending to resist further deformation in the direction of previous strain, but assisting stresses tending to produce deformation in the opposite sense.

The remaining papers, by Messrs. Hailstone and Swinden, are less satisfactory. The latter attacks the problem of the constitution of molybdenum steels by means of numerous cooling-curves and other data, but does not make use of the well-known methods of discussing and considering the equilibria of a ternary system. As a result of this lack of general theoretical guidance in the work, the data lead to no satisfactory conclusion. This want of systematic attack is typical of much of the work which has been done on steel, and especially on alloy steels, and probably accounts for the confusing differences of opinion which still exist in regard to their nature and constitution.

ENTOMOLOGICAL NOTES.

ACCORDING to a note by Mr. J. J. Walker in the September number of *The Entomologists' Monthly Magazine*, 1913 is to rank as a "clouded yellow" year, immigrant specimens of these butterflies (*Colias edusa*) having reached our southern counties in June, and given rise to native broods in August. No British specimen of *C. hyale* had been recorded this year up to the date of the note.

In order to enable planters in Trinidad to cope effectually with the native sugar-cane frog-hopper (*Tomaspis varia*), a member of the family Cercopidæ, the Board of Agriculture of Trinidad and Tobago has issued a pamphlet (Circular No. 9), drawn up by Mr. F. W. Urich, the official entomologist, in which the life-histories of this and certain other members of the same group are very fully described. Three beautifully coloured plates illustrate all the stages of the species forming the main subject of the pamphlet and the adults of its Trinidad relatives. Although reported to have been originally described from Guiana, *T. varia* cannot be identified elsewhere than in Trinidad, and is accordingly regarded as a native of that island. Two charts show that it is most numerous in January, when the rainfall is at its lowest. This mischievous insect is attacked by two kinds of fungus, one of which affords, at present, the best means of keeping it in check; and, with this and other agents, the author is hopeful that the "plague may be stayed" in the near future.

Although holiday-makers roundly cursed the heavy rains of the summer of 1912, they were highly beneficial, in the opinion of Mr. G. H. Carpenter, as expressed in an article on injurious insects observed in Ireland during that year (Economic Proceedings Royal Dublin Society, August) in reducing the great development of insect life due to the abnormally hot summer of 1911.

The editor is indebted to the Rev. R. P. Longinos Navas, S.J., for a copy of a synopsis of the Ascalephides, published in the *Arxius de l'Institut de Ciencias, Barcelona*, vol. i., No. 3. Although these Neuroptera, which are related to the lace-wing flies, are generally classed as a subfamily of the Hemerobiidæ, the author follows MacLachlan in regarding them as representing a family by themselves—Ascalaphidæ. None of these flies are found in the British Islands, but they are abundant in many parts of the Continent, and enjoy an almost cosmopolitan distribution. The present synopsis includes diagnoses of all the known generic and specific types, several of which are named and described for the first time.

Several important entomological articles have recently appeared in the Proceedings of the Philadelphia Academy, notably one in the May and June issues on the grasshoppers of the genus Nemobius. Other papers are published in the July issue of Records of the Indian Museum, in which Mr. J. J. Kieffer reviews the chironomid flies in the collection of the museum, while Mr. K. Jordan does the same for the beetles of the family Anthribidæ.

In describing a new species (*Clomaciella subfusca*) of the mantispid group of Neuroptera in vol. viii., part 2, of *Annotationes Zool. Japon.*, Mr. W. Nakahara takes the opportunity of reviewing the Japanese representatives of the group—eleven in number.

Copies of two entomological papers from vol. xlvi. of the Proceedings U.S. National Museum have been received recently, namely one by Mr. F. Knab on new species of moth-flies bred from bromelias and other plants, and one by Prof. T. D. A. Cockerell on new parasitic Hymenoptera of the genus Eiphosoma.

To the Journal of the College of Agriculture, Tohoku Imperial University, Japan, vol. v., parts 4 and 5, Mr. Yos'himo Tanaka communicates articles, illustrated by one plain and one coloured plate, on Mendelian factors and gametic coupling and repulsion in silkworms.

R. L.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

The Cambridge University Press.—The Fertility of the Soil, Dr. E. J. Russell (Cambridge Manuals of Science and Literature). *Werner Laurie, Ltd.*—The Conquest of the Desert, Dr. W. Macdonald, illustrated. *J. B. Lippincott Co.*—Productive Swine Husbandry, Prof. Dav. *Crosby Lockwood and Son.*—The Cultivation of the Oil Palm, F. Milligan; Coconut Cultivation, H. L. Coghlan, illustrated; British and Colonial Dairying for School, Farm, and Factory, G. S. Thomson, illustrated. *Longmans and Co.*—Maize: its History, Cultivation, Handling, and Uses, with Special Reference to South Africa, J. Burtt-Davy, illustrated. *John Murray.*—Imperial Institute Series of Handbooks to the Commercial Resources of the Tropics, with Special Reference to British West Africa: Rubber, H. Brown. *John Wiley and Sons (New York).*—Exercises in Farm Dairying, C. Larsen.

ANTHROPOLOGY.

John Bale, Sons, and Danielsson, Ltd.—Some Austral-African Notes and Anecdotes, Major A. J. N. Tremearne, illustrated; Hausa Superstitions and Customs, Major Tremearne, vol. ii. *The Cambridge University Press.*—The Peoples of India, J. D. Anderson (Cambridge Manuals of Science and Literature). *Chatto and Windus.*—A History of Babylonia and Assyria from Prehistoric Times to the Persian Conquest, L. W. King; vol. ii., A History of Babylon from the Foundation of the Monarchy to the Persian Conquest; vol. iii., A History of Assyria from the Earliest Period to the Fall of Nineveh, illustrated. *Gurney and Jackson.*—The Antiquity of Man in Europe: being the Munro Lecture on Anthropology and Prehistoric Archæology in connection with the University of Edinburgh, Prof. J. Geikie, F.R.S., illustrated. *Macmillan and Co., Ltd.*—The Golden Bough: a Study in Magic and Religion, Prof. J. G. Frazer, third edition; Part vii., Balder the Beautiful, 2 vols.; The Nine Minoan Periods: a Summary Sketch of the Characteristic Stages of Cretan Civilisation, from the Close of the Neolithic to the Beginning of the Iron Age, with special reference to the Antiquities of Knossos, Sir A. Evans, F.R.S., illustrated; An Atlas of Knossian Antiquities, edited, with explanatory text, by Sir A. Evans, F.R.S.; Marriage Ceremonies in Morocco, Prof. E. Westermarck; The Eastern Libyans, O. Bates, illustrated; Athens and its Monuments, Prof. C. H. Weller, illustrated. *Oxford University Press.*—Rustic Speech and Folk-lore, E. M. Wright; Irish Witchcraft and Demonology, St. J. D. Seymour; The Beginnings of Buddhist Art, A. Foucher, translated by L. A. and F. W. Thomas; Black Glaze Pottery from Rhitsona in Bœotia, P. N. Ure; The Philistines: their History and Civilisation, R. A. S. Macalister. *The S.P.C.K.*—The Chinese People: a Handbook on China, Archdeacon Moule, illustrated. *P. Lee Warner.*—The Book of the Dead: the Papyrus of Ani, Scribe and Treasurer of the Temples of Egypt, about B.C. 1450, Dr. E. A. Wallis Budge, illustrated; Antiquities of India: an Account of the History and Culture of Ancient Hindustan, Dr. L. D. Barnett, illustrated; Mexican Archæology, T. A. Joyce, illustrated; Prehistoric Greek Archæology, H. R. Hall, illustrated. *Williams and Norgate.*—Prehistoric Times, Lord Avebury, new edition, illustrated.

Biology.

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Crossland; The British Rust Fungi (Uredinales): their Biology and Classification, W. B. Grove; Rubber and Rubber Planting, Dr. R. H. Lock; Weeds: Simple Lessons for Children, R. L. Praeger, illustrated (Cambridge Nature Study Series); The Life-story of Insects, Prof. G. H. Carpenter; The Flea, H. Russell; Pearls, Prof. W. J. Dakin (Cambridge Manuals of Science and Literature); Artificial Parthenogenesis and Fertilisation, Dr. J. Loeb. *Cassell and Co., Ltd.*—Cassell's Natural History, F. M. Duncan, illustrated. *Constable and Co., Ltd.*—In Beaver World, E. A. Mills, illustrated. *W. Engelmann (Leipzig).*—Das Darwin'sche Selektionsprinzip, Plate, new edition; Rohstoffe des Pflanzenreiches, Wiesner, new edition; Geschichte der biolog. Theorien, Radl, Bd. i., new edition. *G. Fischer (Jena).*—Organographie der Pflanzen, Prof. K. Goebel, I. Teil: Allgemeine Organographie, new edition, illustrated; Ueber die Traubenwickler, Prof. F. Schwangart, Zweiter Teil, illustrated. *R. 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THE BRITISH ASSOCIATION AT BIRMINGHAM.

SECTION G.

ENGINEERING.

OPENING ADDRESS BY PROF. GISBERT KAPP, PRESIDENT OF THE SECTION.

ENGINEERING, the subject with which Section G is concerned, covers so wide a field that it has been found convenient to introduce a rough subdivision into the three branches of civil, mechanical, and electrical engineering. By applying any such term to a particular piece of engineering work we do not necessarily exclude the others; we merely characterise a predominant feature. There is often a considerable amount of overlapping between the three branches, and that is especially the case with mechanical and electrical engineering. Sometimes the boundary-line even becomes indistinct, and then it is difficult to say which branch of our science is the predominant feature. Is the equipment of a works with electric power mechanical or electrical engineering? It is both, but not necessarily to the same degree. The mere replacement of a steam engine by an electric motor to drive the main shafting of a works can scarcely be called a piece of electrical engineering; but if special electric appliances are introduced to perform duties which cannot be done, or not done as well, by purely mechanical machinery, then we have electrical engineering in the true sense of the term.

Electricity has invaded almost every branch of our industrial activity, sometimes as a rival to older methods, but often also as a helpmate, stimulating progress all round. Electricity is a "great source of power in nature," and the "art of directing it for the use and convenience of man" belongs to our generation. Yet, like all new things, it has had to fight its way in the face of strenuous opposition—generally an absolutely honest opposition, not in any way traceable to self-interest, but simply to inability to see things in the right perspective. Let me illustrate my meaning by an example. Shortly after Charles Brown had established the first electric-power transmission between Kriegstetten and Solothurn I happened to visit a well-known mechanical engineer in Zürich, who had in his time been professionally (not financially) interested in so-called teledynamic transmission of power by wire-rope, first introduced into Alsatia by the celebated Prof. Hirn, of thermodynamic fame, about the middle of last century, and then also imported into Switzerland. To my old friend these transmission systems appeared to be the acme of perfection; and on my pointing out that the range was necessarily very limited, he replied that transmission to longer distances would be useless, since there would be no market for the power. My friend was not able to look at the subject in the right perspective; he failed completely in appreciating the fundamental conditions of the problem, and although it is easy for us now, fortified as we are by experience, to appreciate electric transmission of power correctly and feel contempt for the old gentleman's narrow-mindedness, yet we should be careful not to fall into the same error about electrical developments which are new to us, as the transmission of power was new to my Swiss friend.

It is not so very long ago that mechanical engineers thought there was no advantage in electrifying textile mills; and I do not feel quite certain whether a good many and very capable engineers are not still of the same opinion. A commission has been investigating this subject, and its first report was by no means encouraging to the electrical engineer. Yet at the very time when that report was issued hundreds of motors were being installed in Continental mills. The spinners there had found out that by using a motor with very delicate speed regulation they could speed-up their frames and increase the output considerably. In the long run a good thing must win through, and the electrification of English textile mills is no exception to this economic law; but in some cases it would almost seem that the way is made longer by the narrowness of the mental horizon of opposing experts. This process of gradually overcoming the opposing expert had to be gone through in all applications of electricity, but the opposition being generally honest, once it is overcome, the very men who opposed become strong friends. There is no question now that electricity can do some things better than could be done formerly. The separation of magnetic from non-magnetic material; the lifting of hot pigs, ingots, plates, and scrap by electromagnets; the production of high-grade steel in the electric furnace; the sinking of shafts by electrically-driven pumps; in mines the use underground of electromotors instead of steam engines, in shipyards the use of magnetically-fixed and electrically-driven tools; the electric driving of rolling mills, and the use of electric traction on tube and other underground railways are familiar examples of the application of electricity in which unanimity as to its advantages has been reached between the electrical engineer and what, without any intention of being disrespectful, we may call the old school of mechanical engineers. There are, however, other applications of electricity where the old and new school of engineers have either not at all, or only partially, reached unanimity of opinion, and it is with one of these applications—namely the electrification of railways—that I propose to deal in this Address.

As regards urban and suburban lines, not only the possibility of electric traction, but its immense superiority over steam traction, is fairly generally admitted. Where we get on debatable ground is when we begin to discuss main-line traffic. Here the process of overcoming opposition, of which I spoke a moment ago in connection with other applications of electricity now generally approved, has only just begun. Will it lead to the same result, or will the electrician have to confess himself beaten by the steam locomotive? The answer each one of us would give to this question must necessarily be biassed by our early training. Most engineers love their profession, and are enthusiasts; being enthusiasts, they are necessarily biassed. This applies as well to the electrical engineer as to the mechanical engineer—perhaps to the electrical engineer most. In many cases he is so biassed that he will not admit any virtue in any other but his own pet scheme of electric traction. A modern steam locomotive is a beautiful and efficient engine, and one can well understand its designer looking at it with the pride of a father whose son has turned out a good man. One can also understand that this engineer will not readily admit the superiority of an electric locomotive. The mental horizon of each of us must necessarily be narrowed by previous training and professional enthusiasm; let us, then, try to forget for a moment that we are engineers, and let us put out of our minds all questions of mechanical or electrical detail, focussing our thoughts merely on what we see going on all around us as regards electrification of railways. We see year by year more lines being electrified. Some are failures; but the very fact that in spite of these failures the process of electrification is going on, shows that the failures are remediable.

In some cases it is easy to understand why a line should be electrified. If fuel is dear, if the trains must be heavy and frequent, if there are steep grades and long tunnels, then obviously steam is at a disadvantage and electricity can beat it easily. But the electrification is not limited to cases where there are such obvious advantages. We see a military State like Prussia electrifying a fairly long line where the traffic is not extremely heavy, where there are very gentle grades, and only few and short tunnels. Moreover, one of the stock arguments against electrification is that in case of war the whole system may be broken down by the enemy cutting the wires; yet this consideration, if it has any weight—a matter on which I cannot pronounce an opinion—does not deter a military State from at least experimenting with electric traction on a large scale. We see suburban lines growing longer and longer, until they might almost be classed as short main lines, and we see the Swiss Government buying up water-powers with the object of utilising these powers in the electrification of its most important main lines. We see in America the electrification of large systems taking place, not only for passenger service, but also for the goods service, comprising trains of 2000 and more tons weight, and of goods yards, to the complete exclusion of steam.

One need not be an engineer to appreciate the significance of such a general development. No Government department, and certainly no board of railway directors, will spend money merely for the sake of an interesting scientific experiment, and, although it is conceivable that in an isolated case such an experiment may be undertaken under a miscalculation as to its possible success, it is not conceivable that such a miscalculation should be the general rule. When we see that in all countries a vast amount of labour is devoted to, and capital is spent on, the electrification of main lines, we cannot but come to the conclusion that this new application of electricity is bound to progress, and that the persons who tell you that electric traction is all right for tramways and urban railways, but will never be able to compete against steam traction on main lines, are very much in the position of my old Swiss friend, whose conception of power transmission was entirely limited to the use of ropes and pulleys.

It is just thirty years since the first electric railway was opened for public use. That was a small line in Ireland, known as the Portrush-Bushmills Railway. In those days only the continuous-current motor was available, and that only at a very moderate pressure and power. These restrictions were from the first felt to be a serious drawback, and inventors tried to overcome them in various ways. Of these, two may be here noted, in passing. Ward Leonard in 1891 made the suggestion of carrying on the train a converting station. He argued, quite correctly, that for the transmission of power to long distances the alternating current was eminently suitable, and that, consequently, the power should be sent to the train in the shape of high-pressure alternating current. On the other hand, such a current was, in those days, quite unsuitable for motors; hence the necessity of its conversion into continuous current, with which the then available motors could alone deal. Ward Leonard suggested to put on the first vehicle of the train a synchronous motor, which drives an exciter and continuous-current generator. The current obtained from this generator was to be used to drive the train-motors, which might be distributed in a number of motor coaches. The regulation of speed and tractive force was to be effected entirely by suitable adjustment of excitation, and therefore without rheostatic loss. It will be admitted that this proposal has some attractive features. It is essentially a long-distance system, and at the same time it offers the possibility of great and uniform acceleration, a matter of great importance in urban traffic, so that it is equally suitable for both kinds of service. Moreover, the current can be taken with unity-power factor. Unfortunately the extra weight which has to be carried in the shape of converting machinery is a serious drawback; and for this reason the Ward Leonard system (excellent as it has proved in other applications of electric power) has in the domain of traction never got beyond the experimental stage.

The experiment has been made on a fairly large scale, but with this difference, that the traction-motors were placed not only into motor coaches, but on the first vehicle itself, which thus became an electromotive; also, in order to save the weight and cost of starting and synchronising gear, the asynchronous type of single-phase motor was adopted, thus sacrificing the advantage of unity-power factor. The electromotive developed at the hour-rating 200 horse-power, and weighed 46 tons. This is not a very brilliant achievement, and it was beaten by a sister engine of the same power, but using alternating-current motors. This electromotive weighed only 40 tons.

It is probable that a better weight efficiency could be obtained nowadays with this system if carried out on a larger scale, and if the motor-generator were replaced by a converter, in which case the step-down transformer would have tappings on its secondary side for starting and regulation. It is, however, doubtful whether even then it could compete with electromotives using the alternating current in the motors directly. Motors of this type have recently been so much improved that the margin of weight that could be saved by the use of continuous-current motors is probably less than the excess weight of the converting machine.

The other attempt to combine high trolley-voltage with low motor-voltage has shared the same fate. This consisted in the application of the three-wire principle of continuous-current supply to electric traction. It is in successful operation at a moderate voltage on a London tube railway, but as far as main-line working is concerned it has not got beyond an application on two small lines in Bohemia. The principle adopted is to make the trolley wire of the up-line the positive and that of the down-line the negative side of the system, whilst the rails take the place of the zero wire. Each electromotive is fitted with four motors, of which at least two are in series, taking 1500 volts. Thus, whilst the voltage of one motor is kept within the customary limit of 750 volts, the pressure of the whole system is 3000 volts. The objection to this arrangement is that its fundamental supposition of a fairly close balance between the two halves of the three-wire system must in actual railway working be rather the exception than the rule, and that the obvious remedy of combining both halves of the system in one and the same train would involve the use of two overhead trolley wires, and thus introduce the very feature which the advocates of the continuous-current system find so objectionable in three-phase traction. Moreover, the recent improvements made in continuous-current motors has reduced the importance of the three-wire principle. Continental makers are prepared to build motors for 1200 volts, and one English maker is actually building motors for 1750 volts, so that with two motors in series a trolley-pressure of 2400 and 3500 volts respectively can be used.

The present tendency in electric traction is in the direction of simplicity, in the sense that mixing up of different types of current and dependence of one train on another is avoided. Only three types of current are used—namely continuous, three-phase, and single-phase. The two first-named are used direct; the last through the intervention of a transformer. In a large measure the different systems have already become standardised. As regards the C.C. system, up to 750 volts the process of standardisation has been completed long ago. It is almost generally adopted for urban and suburban lines of moderate length, unless there are local difficulties as regards the third rail, or it is desired to work the suburban and the main-line service on the same system. The three-phase system has also been fairly well standardised, but the single-phase system is still in a process of development—a development which, however, takes place on a fairly large scale. In France the Compagnie du Midi is electrifying on the single-phase system nearly 400 miles of track; the German Government have already electrified the Dessau-Bitterfeld of the Leipzig-Magdeburg line, and are electrifying the line Lauban-Koenigszelt in Silesia, to say nothing of some smaller private lines in the south of Germany, which have been in operation for some years. In Switzerland the Berne-Loetschberg-Simplon Railway, already in operation, and the Rhætian Alp Railway, nearing completion, also employ single-phase electromotives. Both in France and Germany the type of electromotive to be finally adopted has not yet been settled, but half a dozen different types, supplied by as many different makers, are being tried, and it is in this respect that one may look on single-phase traction as still in the process of development. As regards the Loetschberg the period of trial is over. Three years ago the railway company ordered a 2000 horse-power electromotive, and have had it at work ever since with such satisfactory results that they have decided to adopt this type definitely, and have ordered thirteen more engines, but of the slightly larger power of 2500 horse-power on the 1½-hour rating. Of these I shall have to say something more presently; but before entering into the details of single-phase traction it is expedient to glance briefly at the present position of the rival system of three-phase traction.

The first application of this method of working dates back to the end of last century, and took place on a small Swiss line; then followed the well-known Valtellin line, and, later still, when the Italian Government took over the railways, the Government engineers decided to extend the application of three-phase traction to some other lines—a decision which practical experience has shown to have been perfectly justified. The total power represented by three-phase electromotives either at work or on order in Italy to-day exceeds 200,000 horse-power (95,000 horse-power in service, and 120,000 horse-power building). Ten years ago the three-phase system was the only possible one for main-line working, but later on there came on the scene the single-phase, and, later still, the high-pressure continuous-current systems, and I need scarcely mention that between the advocates of the three systems there has been waged a fierce battle, each claiming that his is the best and the others very inferior. I am afraid that battle is still raging; but it is a futile war, for there is no such thing as a best system generally. One system is the best for one set of conditions and another for another set. Thus the German railway engineers found that the single-phase system would serve them best, and they adopted it. There is in this matter no question of personal feeling or national prejudice. I have no intention to enter the lists as an advocate for any one of the three possible systems for main-line traction; each has its special features and special merits, and all I can do is to place before you some of these. As the three-phase system is the oldest, it will be convenient to take it first.

It is curious to note that the three most obvious objections which have been raised against three-phase electromotives by theorists have been found to have but little weight in practical work. These objections were: the complication of a double overhead wire, the danger that the motors would not share the load fairly, and the inability to run without rheostatic waste at intermediate speeds, or to run at a higher than synchronous speed to make up for lost time.

That an overhead wire is inconvenient must be readily admitted, but the inconvenience applies to all methods of main-line working, for the so-called third rail is not applicable to high pressure, and even if it were, the consideration of the safety of the platelayer would preclude its use. The question then is: are two wires twice as objectionable as one? Possibly, but the most objectionable feature is not the wire itself, but the posts or gantries on which it is carried, and the number of posts is the same, whether we use three-phase, single-phase, or continuous current. There is a little more complication at the cross-over points and at the switches; but this is not a serious matter, if one may judge from the perfectly smooth working of so extended a yard as that at Busalla, where there are five miles of track, connected by thirty-seven switches and crossings. The other objection—as to the motors not sharing the load equally—is theoretically sound. The torque developed by the motor is proportional to the slip, and in order that the two motors on an electromotive shall share the load equally their slips, and consequently also their speeds, must be the same. Now, it is conceivable that, owing to a slight difference in the size of the drivers, that motor which is geared to the larger drivers will, by reason of its lower speed and consequently greater slip, take more than its fair share of the load. In practice this difficulty does, however, not arise. With reasonably good workmanship there should be no sensible difference in the size of the wheels; but even if we admit the possibility of there being a difference of ½ per cent. in the diameter of the wheels, this would, with the usual slip of 3 per cent., only mean that the motor geared to the larger wheels develops 8 per cent. more, and the other 8 per cent. less, than its normal power. The larger wheels will develop 16 per cent. more tractive effort than the smaller wheels, and having thus a greater wear, the difference originally existing will diminish in service. For the same reason, any tendency to wear unequally, say, in consequence of unequal material, is counteracted by the slip-adjustment of the motors. This point has been tested practically by the makers of the Simplon three-phase electromotives. It was found that if originally a slight difference in diameter of the drivers had been permitted to exist, after a short time this had vanished. That is as regards the condition on one electromotive; but if we come to the case of a train being hauled by two engines, then a sensible difference in the size of their wheels may exist. In this case it is necessary artificially to adjust the slip so as to make each motor take half the load.

This problem has been solved by Mr. v. Kando in the electromotives which he designed for the Italian State railways. In these engines only liquid resistances are used in the rotor circuit for starting and speed regulation. The liquid is raised or lowered in the rheostat chambers so as to cover more or less of the contact plates, and the level of the liquid is controlled by a solenoid under the influence of the working current. The working current, and therefore also the tractive effort exerted by each motor, is thereby automatically kept constant, notwithstanding any difference that may exist in the size of the drivers on the two electromotives. Incidentally, it may be mentioned that this method of liquid rheostat control has also the advantage of a perfectly constant acceleration during the starting period—a point which makes for comfort of travel in a three-phase train.

The third objection advanced by theorists against three-phase traction is against the waste of energy consequent on rheostatic speed control and the inability to run at more than synchronous speed so as to make up for lost time. The obvious remedy for the last-named difficulty is to fix the time-table so that the synchronous speed should be high enough for making up lost time and to employ motors which can run economically at less than synchronous speed. As a matter of practical experience, three-phase trains are not more unpunctual than any other kind, steam not excluded. A train pulled by a series motor (C.C. or A.C.) runs slower on an up-grade or if abnormally heavy; this is one of the characteristics of the series motor, and it is valuable, because it limits the excess load thrown on to the source of power; but it is clearly not a condition making for good time-keeping. With a series motor time lost cannot be recovered on an up-grade, whilst with a three-phase motor the speed on an up-grade may be kept practically the same as on the level or on down-grades, so that the process of gaining time is not restricted to the easy parts of the line.

The problem of speed control without rheostatic waste has been solved in various ways. One of the simplest and generally adopted solutions is that of cascade and single working. If the two motors are put into cascade connection the speed is halved. The cascade is used in starting and on heavy grades (unless time has to be made up), and on the easy grades or on down-grades the motors work singly—that is to say, in simple parallel connections. Intermediate speeds may be obtained by some pole-changing device. Ordinarily, such devices have to be applied to stator and rotor, but in some of the Simplon electromotives only the stator is arranged for pole-changing, the rotor being a squirrel cage. In this arrangement the advantage of cascade-working has to be given up, but the system has the merit of great simplicity. The number of poles may be changed from twelve at starting to eight, six, and four at top speed. Thus, four different speeds, all without rheostatic waste, are possible. The single bars in the squirrel cage rotor are connected at their ends by resistance-connectors made of an alloy having a high temperature coefficient. At starting the rotor current is large and heats up these strips, thus automatically providing what is technically termed a starting-resistance. When the motor is running the current is less, and by reason of the fanning action of the connecting-strips these get cooled so as to bring their resistance down to a permissible amount. Thus the efficiency of the motor when running under load is only a few per cent. less than that of a motor with a wound rotor.

A valuable feature of the three-phase system is the automatic recuperation of current whenever the speed exceeds synchronous speed by a few per cent.: and, connected with this property is the further advantage that it is impossible for a train to race on a down-grade. Obviously recuperation can only take place if power is given to the motor. This is provided partly by the electromotive itself and partly by the train pushing it on a down-grade. This means that the train is braked in front only, and railway engineers have raised the objections that such a method is contrary to the accepted rules for safe working, which require that even on a down-grade all the couplings should remain in tension, which means that each coach must be independently braked. Here we have again a case where the theorists' objections have been proved to be without foundation in actual practice. It is no doubt objectionable to brake a train in front only, if the braking action is jerky; but with the automatically controlled liquid rheostat the braking comes in quite gradually, and is throughout so even that it has been found possible to permit a higher down-grade speed with recuperation than with ordinary braking. On the Italian State railways the regulation permits on heavy down-grades a speed of thirty kilometres per hour for steam trains, but the electric goods trains on the Giovi line are permitted to run at forty-five kilometres per hour. This concession is not extended to passenger trains. Nevertheless the economic effect is considerable. Recuperation saves 17 per cent. on the coal bill, and this amount is sufficient to provide for interest and sinking fund on the electrical plant at the generating station.

One advantage of three-phase traction over steam traction is the lessened weight of the locomotive in comparison with its tractive force and power. As an example, we may take the Giovi line in Italy where steam trains, consisting of 310 tons of rolling-stock and 202 tons of locomotive (one in front and the other at the back), have been replaced by three-phase trains, consisting of 380 tons of rolling-stock and two electromotives, each weighing 60 tons (also placed front and rear). Thus there has been a saving in total weight of 12 tons, and at the same time an increase in useful weight hauled of 70 tons. The average grade of this line, over which passes the whole traffic between the Port of Genoa and the Plain of Lombardy, is 27 per mille, and the maximum is 35 per mille. This traffic is now worked with forty electromotives, each of 60 tons weight. These engines have five driving-wheels connected to two eight-pole motors by gear-wheels and rods. The pressure on each driving-axle is 12 tons. Each electromotive develops 2000 horse-power at the hour-rating; thus 1 horse-power is obtained for each 30 kilogramme weight of engine.

The number of patented designs for single-phase traction motors is very large; but, notwithstanding considerable difference in matters of detail, all motors which have been successfully applied in practice may be ranged under three great groups—namely, the so-called repulsion type, the repulsion type with additional excitation of the rotor, and the straightforward series motor. The present tendency is rather in favour of the series motor, and the practical results obtained with it are certainly very promising. The latest design made by Dr. Behn-Eschenburg shows a remarkable weight efficiency. His 2500 horse-power electromotives (the power being at a one and a half-hour rating) weigh only 108 tons, so that at this rating 1 horse-power is obtained with a total weight of 43 kilogrammes. This compares favourably with the high-pressure C.C. system, where 50 to 70 kilogrammes per horse-power may be taken as normal values.

The so-called "repulsion motor" invented by Prof. Elihu Thomson has been applied to railway work in the slightly modified form due to Mr. Deri, where, instead of there being only two brushes per pair of poles, double the number is provided, and the adjustment for speed and torque is made more accurate, whilst at the same time the commutation, being split up into two steps, becomes easier. In the matter of simplicity, an electromotive fitted with Deri motors cannot be surpassed by any other arrangement. There are no rheostats, contactors, control switches, or other gear; all the regulation is effected by mechanical transmission of the movement of a hand-wheel placed in the driver's cab to the brushes of the motors. At one time it was hoped that this system would win its way to a general application; but, unfortunately, the motor must run somewhere near synchronous speed, and becomes therefore rather heavy with the low frequencies alone possible in traction. Moreover, as the power-factor obtainable is only about 0·80, that is, considerably below the value obtainable with other motors, there does not seem to be any great future for this system for heavy work, although its great simplicity may still turn the balance in its favour on lines with a light traffic. For heavy lines the choice at present lies between the induction motor, with direct rotor excitation, and the straightforward conduction-motor, where rotor and stator are traversed in series by the same current. The former type of motor—also called the Latour-Winter-Eichberg motor—depends for its working current in the rotor on electromagnetic induction, which produces the working current in the rotor much in the same way as the current in the secondary circuit of a transformer is produced by induction. Since the motor has in part the character of a transformer its weight would, as is the case with any transformer, be unduly augmented by too great a reduction in the frequency. Experience has shown that a frequency of twenty-five periods per second is high enough to render the transformer action effective, and at the same time not so high as to introduce serious difficulties as regards e.m.f. of self-induction and commutation. This frequency has been adopted in most cases where electrification of main lines has been carried out by motors of this class.

One valuable feature of this motor is that at a speed slightly exceeding synchronism the power-factor may be brought up to unity. At this speed the commutation takes place under conditions which may be described as theoretically perfect. A fair number of Continental lines have been electrified by using these motors, and they have also been adopted, with very satisfactory results, in the electrification of the London, Brighton and South Coast lines between Victoria and London Bridge and to some distance south of London. On this line no locomotives are used, but only motor coaches. It is therefore not possible to make a direct comparison as to weight efficiency with a locomotive. The latter has only to carry the propelling machinery, whilst the former has to provide accommodation for passengers as well. The 600 horse-power motor coaches on the Brighton line weigh 50 tons, or at the rate of 83 kilogrammes per horse-power. A 1000 horse-power C.C. electromotive taking current at 1200 volts weighs 74 tons.[1] By making a suitable reduction for the extra weight of the passenger accommodation in the A.C. coach, its weight per horse-power comes out at something like 60 kilogrammes, against 62 kilogrammes in the C.C. engine.

Series motors are employed on the electrified lines of the Midland Company between Heysham, Morecambe, and Lancaster. Also in this case motor coaches, and not electromotives, are used. At the hour-rating a motor coach develops 420 horse-power, and as its total weight is about 35 tons, we have here the same weight-efficiency as on the Brighton lines—namely, 83 kilogrammes per horse-power for the whole coach.

Of high-pressure continuous-current lines there are many examples, both in Europe and America. The term high-pressure does, of course, not imply the same order of magnitude as in single-phase A.C. lines. There high-pressure may mean anything up to 15,000 volts, the pressure which is likely to become a standard in future electrifications; but in C.C. work one must class anything over 1000 volts or 1500 volts as high-pressure. The general rule is to employ motor coaches, and not electromotives; but there is a private line belonging to a steel-works in Lorraine, where two electromotives, each of 600 horse-power (four C.C. motors of 150 horse-power) are working the mineral trains under a pressure of 2000 volts. The Southern Pacific Railway also employs C.C. electromotives of 1000 horse-power each. Each engine weighs 74 tons, and hauls a train of 270 tons on grades of 40 per mille. This is a remarkable performance, rendered possible by the fact that with the even torque exerted by the electric motor a much large co-efficient of friction than is possible in steam traction may safely be permitted. Electrical engineers generally base their calculation of the possible tractive effort on a co-efficient of 0·17, without sand, and as high as 0·25, or even 0·28, if sand is used. The voltage in the case of the Southern Pacific engines is only 1200 volts, taken by two motors in series, and there is provision made to change over from the overhead wire to third rail, with 600 volts, when the motors are all in parallel.

On European C.C. lines the voltage is higher—generally 2000 volts, as on the Chur-Arosa and some other Swiss lines—and the tendency is still in the direction of higher pressures. Continental makers are now prepared to go as far as 1200 volts per motor, so that with the usual system of series-parallel control a line-pressure of 2400 volts becomes possible. The greatest step in advance in this direction has, however, been made in England, where Messrs. Dick Kerr, Ltd., have adopted a line-pressure of 3500 volts as their standard, involving the use of motors constructed for 1750 volts. After having experimented with this high-pressure system for two years, they have undertaken the electrification of a short section of the Lancashire and Yorkshire Railway with continuous current at 3500 volts. I am indebted to the firm for the following particulars: The current is collected by pantograph from an overhead wire with catenary suspension. The train consists of a motor coach and two trailers. The motor coach is equipped with four 300 horse-power motors, and weighs 62 tons; the trailers weigh each 26 tons. From these figures it will be seen that the weight of the motor coach per horse-power is only 52 kilogrammes, and thus considerably below what the weight of an equivalent single-phase motor coach would be. It is especially the saving in weight and the avoidance of any telephonic disturbances which renders the C.C. system so attractive that, in spite of

1 See Gratzemueller's paper read at the Paris meeting of the I. E. E. and S. Intern. des Electr. (Paris, May, 1913).

a natural reluctance against the use of high-pressure on a commutator, designers are giving increased attention to the use of continuous current for electric traction. The difficulties which some engineers anticipate with commutator and brushes seem, however, rather imaginary than real, if we may judge from the experience with the 3500-volt motor coach. The makers inform me that they estimate the mileage for a set of carbon brushes at 50,000 miles. The motors drive the car-axles by single reduction gear, and are controlled by contactors operated from a master controller. The current for operating the contactors, driving the air-pump motor, and for the general service of lighting and heating is obtained from a small motor-generator, fed on the primary side at 3500 volts, and delivering C.C. at 210 volts. All motors have commutating poles—a practice which has become universal in C.C. traction work.

From the figures quoted above it will be seen that where motor coaches are employed the C.C. system has an advantage in point of weight over the single-phase A.C. system. But main-line traction, including goods trains, is not going to be done by motor coaches, and if we come to large electromotives of some 2000 to 3000 horse-power, then this advantage is likely to vanish. No high-pressure C.C. electromotive has as yet been built for so large a power, and it is therefore not possible to make a direct comparison; but, if we may judge from the largest engines yet built for moderate-pressure C.C. there is little probability that the C.C. system for high-pressure can beat the single-phase system, and none whatever that it can beat the three-phase system.

In the early days of single-phase traction some trouble has been experienced in the matter of telephonic disturbance. A systematic investigation carried on for over a year on the Seebach-Wettingen line, chiefly by means of the oscillograph, showed that this trouble was due, not as had originally been suspected, to the commutator, but to the employment of open slots in the rotor, and the trouble nearly ceased when new rotors with semi-closed and spiralled slots were used. To improve the telephonic service further the usual remedy of metallic return and drilling the telephone lines was employed. Although by these means it is possible to render telephonic speech over a line alongside a single-phase railway nearly, and perhaps quite, as clear as it is along a C.C. railway, there still remains the danger that the telephone lines may, by electrostatic induction, acquire a very high potential. The remedy against this danger, first applied on some Swedish experimental lines, is to short-circuit the two wires of each circuit by a choking coil of very high inductance, the centre of which is earthed. The static charge is thus carried off to earth, whilst the telephonic currents are only inappreciably weakened.

One of the advantages possessed by the alternating over the continuous current is the simplicity of regulation. There are no contactors and no rheostats used, the power and speed of the motors being adjusted by the use of tappings on the secondary side of the transformers. As transformers are necessary in any case in order to work with a high voltage on the trolley, the introduction of tappings does not materially increase the weight, whilst at the same time it effects a great reduction in the primary starting current. The only difficulty that still remains is that of sparkless commutation, and inventors have evolved many, and sometimes very complicated, arrangements for overcoming it. As so often happens with engineering problems, the most simple solution is, after all, found to be the best in practice; and of all the ingenious inventions patented during the last ten years very little use is made by the designer of traction motors.

Broadly speaking, only two methods are in use; the one is the method first made known by Messrs. Winter and Eichberg, where the working field is produced by direct excitation of the rotor and the transformer e.m.f. in the coils short-circuited by the main brushes is balanced by an e.m.f. of rotation due to a transverse field; and the other method applicable to the straightforward series motor, where a non-inductive shunt is connected to the terminals of the compensating or commutating winding. The effect of a non-inductive shunt is to make the armature field slightly leading over the field produced by the compensating winding. The resultant of these two fields is in position coincident with the brush axis, but has in point of time a phase difference of a quarter period over the working current, thus balancing the e.m.f. of self-induction, which lags by a quarter period. Obviously this balancing effect can only take place when the motor is running, since it depends on the balance between an e.m.f. of self-induction which is independent of speed and an e.m.f. of rotation which is proportional to speed. At starting, when there is no speed, there is no compensation. Thus there would appear to be a new difficulty in the way of the use of single-phase current; but also this has been overcome in quite a simple manner. Experience has shown that a potential difference of 7 volts between heel and toe of brush, and a current density of 15 A. per sq. cm. is permissible.

If, then, we use narrow brushes, covering at any time not more than three segments, use coils of only one turn to each segment, and work at a reasonably low frequency, and not too high a total flux, it is possible to keep the transformer voltage and current density well within the above limits. This is not a severe limitation, for it enables the designer to use a flux out of one pole of 2·4 megalines if the frequency is 25, and 3·6 megalines if it is 15. The number of poles has then to be selected in accordance with the power desired. Obviously the lower periodicity is to be preferred, because the motor may be built with a lesser number of poles, and will then occupy less room—a matter of considerable importance considering the limited space which is available in an electromotive. The frequency of 15 has also some other advantages over that of 25. The e.m.f. of self-induction is proportionately less, and, in consequence, the power-factor is about 5 per cent. better. The skin effect in the rails is much reduced, and also disturbances on neighbouring circuits which may be due to inductive or capacity effects. On the other hand, the generators become a little more expensive and the transformers on the electromotives a little heavier. But, notwithstanding these drawbacks, the balance of advantage is with the lower frequency, and that is the reason why the Commission of Experts called together in 1904 by the Swiss Government to establish standards for the electrification of the Swiss railways has decided that 15 shall be the standard frequency, with a tolerance down to 14, and up to 16⅔. Since then other States have fallen into line, so that 15 is now the standard frequency nearly all over the continent of Europe. The standard pressure is likely to be 15,000 volts. For three-phase tractions the standard pressure is 3000 to 3300 volts.

The subject of electric main-line traction is so vast that in the limited time at my disposal I have only been able to mention a few of the important features of this interesting problem. A detailed account of all that has been done in electrification would take far more time than we can spare; but, by way of example, I give below two tables referring to the Italian State Railways. I am indebted for the information to Mr. v. Kando, who may justly be described as the father of three-phase traction.

Italian State Railways Electrified on the Three-phase System.

Location of line	In service			In construction		
	Lecco Colico Sondrio Chiavenna	Campasso Pontedecimo Busalla	Bussoleno Bardonecchia Modane	Savona S. Giuseppe Ceva	Lecco Monza	Genova Sampierdarena Ronco
Length, in kilometres	107	19	58	45	38	28
Heaviest grade per mille	22	35	30	25	12	17
Numbering of transforming stations ...	10	4	7	4	4	2
Transmission voltage	20,000	13,000	59,000	62,000	25,000	57,000
Trolley voltage ...	3,000	3,000	3,300	3,300	3,300	3,000
Frequency (cycles per second)	15	15	$16\frac{2}{3}$	$16\frac{2}{3}$	$16\frac{2}{3}$	15
Source of power ...	Water	Steam	Water	Water (steam reserve)	Water (steam reserve)	Water (steam reserve)
Number of electromotives	14	20	15	61 for the three lines		
Number of motor coaches	10	—	—	—	—	—
Weight of trains, minimum	150	190	—	not given		
Weight of trains, maximum	370	380	220			

Three-phase Electromotives on the Italian State Railways.

Type	034	036	038	050	030
Maker	Ganz	Ganz	Ganz	Westinghouse	Westinghouse
Number in service ...	2	3	4	40	—
Number building ..	—	—	—	45	16
Total weight, tons ...	45	62	62	60	65
Weight on drivers ...	45	43·5	43·5	60	48
Number of driving axles...	4	3	3	5	3
Total number of axles	4	5	5	5	5
Weight on drivers, tons	11·3	14·5	14·5	12	16
Diam. of drivers, m.m.	1,396	1,600	1,600	1,570	1,630
Frequency (cycles per second)	15	15	15	15	$16\frac{2}{3}$
Method of transmitting torque of motor to driving axles	Quill and flexible coupling	Cranks and connecting rods			
Speed, in kilometres per hour	30	32—64	22—45—63	22·5—45	37·5—50—75—100
Method of speed regulation	—	Cascade	Cascade	Cascade	Cascade and pole-changing

The most recent example of single-phase electrification is that of the Loetschberg line establishing direct communication between Berne and the Simplon line. I am indebted to Dr. Behn-Eschenburg, the designer of the electromotives, for the following information. The power at the one-and-a-half-hour rating is 2500 horse-power, and the total weight of the engine is 108 tons, of which 85 tons is taken by the five driving axles. At the normal speed of 50 kilometres per hour the tractive effort is 10 tons. This can be increased at starting to 18 tons. On the heaviest grade (27 per mille) the tractive effort is 13·5 tons, which suffices for a train of 310 tons. The maximum speed is 75 kilometres per hour. There are two 1250 horse-power motors on each engine. Each has its own transformer and controller, the principle of duplication being carried out in all the details, so that in the event of a defect to any one part the other remains serviceable. The potential difference between tappings is 45 volts, and the last step gives with 15,000 volts on the trolley 520 volts. This is in excess of what is required by the motor, and thus provides for the event that the trolley-voltage should for some reason fall below the standard pressure. The normal voltage of the motors is 420, and the full-load current 2700 A. At starting on the level the line-current is about one-third of the full load-current, and the power 10 per cent. of the full power. When starting on an up-grade of 27 per mille with a train of 310 tons, the current taken from the trolley is 40 per cent. of the normal full-power value, and the acceleration 0·05 metres per second per second. The current is taken from the overhead trolley by two pantographs, the pressure being 15,000 volts, and the frequency 15. The controller drums are each worked by an electromotor and rocking pawls under the electric control of a master controller, so that the driver is relieved of any physical exertion in attending to the regulation of the motors. These have 16 poles, a compensating winding to increase the power-factor, and commutating poles shunted by a non-inductive resistance to insure sparkless collection. The power-factor is about 0·95 over a wide range of load. The motor is geared by double helical wheels (ratio 1 : 2·23) to a blind axle, from which the turning moment is transmitted to the drivers by cranks and connecting-rods. The weights are as follows: Motor, 11·8 tons; gear, 2 tons; transformer, 7·5 tons; and controller, 1 ton; total, 22·3 tons; or at the rate of 17·8 kilogrammes per horse-power on the one-and-a-half-hour rating. The total weight of the electromotive is at the rate of 43 kilogrammes at the same rating. This is a remarkably high weight-efficiency, which has up to the present not been reached by any continuous-current electromotive, and has only been surpassed by the three-phase 2000 horse-power electromotives (taken at the one-hour rating) of the Italian State railways, which works out at 30 kilogrammes per horse-power.

In conclusion, let us briefly glance at what is being done in the electrification of the Gothard line, that main link of commerce between Germany and Italy. I am indebted for the following notes on the subject to Mr. Huber-Stocker, the scientific adviser to the Swiss Government in the matter of railway electrification: The part to be electrified first is that between Erstfeld and Bellinzona, a total length of 110 kilometres, of which about 29 per cent. is in tunnel. This part also contains the longest and heaviest grades, so that the limitations of steam as compared with electric traction are here most prominent and a relief most urgent. On this section the average daily train movement, taking both directions together, was, in 1911, not less than 1,680,000 kilometre-tons, and the maximum on any day 2,282,000 kilometre-tons. It is estimated that in 1918 the average train movement will have increased by 35 per cent. over 1911, and in 1928 by a further 30 per cent. In the 45 kilometres on the north side of the tunnel the train climbs 569 metres, and in the 65 kilometres on the south it descends to Bellinzona 900 metres, with a steepest grade of 27 per mille. The section Erstfeld-Airolo is to be opened for electric traction in four years from now, and the southern section one year later. The present arrangements are made with the intention of extending the electric service on the north to Lucerne (60 kilometres), and on the south to Chiasso (55 kilometres) at some future date not yet fixed. There will be two large power-stations, one at Amsteg, where at first 32,000 horse-power will be available on the turbine shafts, and 56,000 to 60,000 when the station is completed; and the other at Piotta, where at first 40,000, and finally 50,000 horse-power will be available. The head of water in the northern power-house is 267 metres down to the Reuss, and an accumulation of one million cubic metres is provided for to compensate for diurnal variations. In the southern power-house the head of water is 900 metres, and there the Ritom Lake offers a natural reservoir, with 19 million cubic metres, to mpensate for annual variation in the water-supply. he power-current will be sent along the line by two dependent cables, each capable of carrying the full ower at twice 30,000 volts, with earthed neutral. The urrent will be transformed down to 7500 volts at first, nd 15,000 volts later on, if the experience gained with the lower pressure should warrant the increase to double pressure. This will not involve any additional plant, since the secondary winding of transformers both along the line and on the locomotives can from the first be arranged with this alteration in view. It is also contemplated to establish sub-stations in Biasca, Goeschenen, Lavorgo, and Bellinzona The trolley wires will be suspended from gantries, each wire independently insulated. The section varies according to the gradient from 100 to 160 square millimetres. The feeders are separate for the up and down line, and are 100 square millimetres in section. At all railway stations there are change-over switches for trolley wire and feeders. In the tunnels the wires are carried by brackets fastened to the crown of the tunnel. The rails will be bonded, and, in addition, there will be a bare return conductor either laid in the ground or placed between the trolley wires. A variation in the supply of voltage of from plus 10 to minus 15 per cent. is allowed for. There will be no motor coaches used, only electromotives. It is intended to haul express trains weighing 420 tons with a speed of 50 kilometres per hour on grades of 26 per mille, for which service the electromotive will have to develop 3000 horsepower on the rails. Goods trains weighing up to 670 tons will run with a speed of from 27 to 28 kilometres per hour, and have two electromotives. one in front and one in the rear, each rated at 2800 horse-power. Passenger trains will be heated by steam, the boiler being carried in a special heating coach. Except for the stipulation that the traction must be single-phase at 15 frequency and a voltage of 7500, which may eventually be raised to 15,000, no definite type of electromotive has as yet been selected, but there can be no doubt that several of the already existing types of mono-phase electromotive can be adapted to the special requirements of the Gothard line.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—Prof. P. F. Frankland, F.R.S., has been elected dean of the faculty of science in succession to Prof. S. M. Dixon.

Dr. F. C. Lee has been nominated to the chair of civil engineering vacated by Prof. S. M. Dixon.

Cambridge.—The director of the psychological laboratory has appointed Mr. Cyril Burt, psychologist to the London County Council, to be assistant in experimental psychology.

The professor of zoology and comparative anatomy has appointed Mr. T. J. Saunders to be demonstrator of comparative anatomy.

At Emmanuel College, Mr. J. B. Peace, bursar of the college, resigned the tutorship in mathematics at Michaelmas, and Mr. P. Worsley Wood has been appointed his successor. The exhibition of 50*l.* offered to a research student commencing residence this October has been awarded to Mr. J. Conway Davies for research in history. An additional exhibition of 30*l.* has been awarded to Mr. H. Ogden for research in physics.

The next combined examination for fifty-six entrance scholarships and a large number of exhibitions, at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 2, and following days. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural sciences. A candidate for a scholarship or exhibition at any of the six colleges must not be more than nineteen years of age on October 1. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained.

Glasgow.—Prof. Archibald Barr has resigned the Regius chair of civil engineering and mechanics, which he has held since 1889. The magnificent James Watt engineering laboratories, in which the department is accommodated, were erected and equipped under his direction. The Crown has appointed Prof. J. D. Cormack, dean of the faculty of engineering in University College, London, and a governor of the Imperial College of Science and Technology, to the vacant chair. Prof. Cormack is a graduate of Glasgow, and was formerly a lecturer in the engineering department.

Mr. C. R. Bury has been appointed assistant lecturer and demonstrator in chemistry at the University College of Wales, Aberystwyth.

A gift of ten lakhs of rupees for the promotion of scientific technical knowledge has been made by Dr. Rash Bahari Ghosh to the University of Calcutta.

The McCosh professorship of philosophy at Princeton University has been resigned by Prof. A. T. Ormond, who has accepted the presidency of Grove City College.

We learn from *Science* that by the will of Miss Katherine Allen, of Worcester, the Worcester Polytechnic Institute has received a bequest amounting to about 20,000*l.*

Mr. L. C. Plant has resigned his position as head of the department of mathematics in the University of Montana on accepting a similar post in the Michigan Agricultural College. He is succeeded by Dr. N. J. Lennes, of Columbia University.

By a trust settlement of Dr. Gavin P. Tennent, of Bath Street, Glasgow, the sum of 25,000*l.* is bequeathed to the governing body of the University of Glasgow, to be applied for such objects or object in connection with the faculty of medicine as the trustees may determine.

The Gresham lecturer on astronomy, Mr. Arthur R. Hinks, F.R.S., will deliver a course of four lectures on astronomy in daily use on October 14, 15, 16, and 17, at 6 p.m., at the City of London School, Victoria Embankment. The subjects of the four lectures are respectively:—The determination of time; the distribution of time; the determination of position; and measurement of the size and shape of the earth. The lectures are free to the public.

A strong committee, mainly consisting of old students of the Royal Agricultural College, Cirencester, is about to issue a special appeal with the view, in the first place, of collecting the balance of 1685*l.* still required to complete the 5000*l.* necessary to secure the advance of a similar sum from the Development Fund for erection of King Edward's wing of the college. When this sum has been subscribed, the appeal will still be continued so as to provide for further much needed extensions The honorary secretary of the committee is Mr. A. Goddard, Surveyors' Institution, 12 Great George Street, Westminster.

THE London County Council has arranged for three courses of free lectures at the Horniman Museum, Forest Hill, S.E., during the autumn, viz.:—On Saturday afternoons, at 3.30 p.m., beginning October 11, a course of ten lectures as follows: Nature study in a Croydon garden, E. Lovett; folk-lore of the Balkan peoples (II.), A. R. Wright; native arts and crafts in British New Guinea, Dr. H. S. Harrison; weeds and their influence, Dr. E. Marion Delf; the origin and nature of teeth, Dr. W. A. Cunnington; a folk-lore tour in the southern counties of England, E. Lovett; the history of coined money, A. R. Wright; the evolution of man in the light of recent discoveries, Dr. H. S. Harrison; animal life in the great caves, H. N. Milligan; the stone monuments of prehistoric times, A. L. Lewis. On Wednesday evenings, beginning October 29, a course of five lectures by Mr. H. N. Milligan on the animal life of the sea-shore. On Saturday mornings, beginning October 11, a course of ten lectures to teachers by Dr. A. C. Haddon, F.R.S., on the ethnology of India. Tickets are required only for the Saturday morning lectures, and may be obtained from the museum.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 22.—Général Bassot in the chair.—**A. Chauveau**: Comparison of vigorous and feeble organisms from the point of view of their aptitude for receiving and cultivating virulent organisms. According to the views at present generally held, a strong, healthy man is less readily attacked by tuberculosis or other contagious diseases than cases where the body has been weakened by alcoholism or other causes. This view is strongly controverted by the author, who refers to the experimental infection in 1868 of sixty healthy animals by tubercle; not one escaped the infection. Additional experiments on the transmission of scab to sheep are now given. Neither the healthy nor enfeebled subjects escaped.—T. **Levi-Civita**: Torricelli's theorem and the commencement of flow.—Edouard **Heckel** and Cl. **Verne**: Cultural bud mutations of *Solanum immite, S. Jamesii*, and *S. tuberosum*.—R. **Lépine** and **Boulud**: The intra-renal resorption of chlorides in various states of the kidney.—P. **Chofardet**: Observations of the Metcalf comet 1913*b*, made at the observatory of Besançon with the bent equatorial. Data given for September 7 and 11. The comet was of the ninth magnitude, nucleus badly defined, and no tail visible.—P. **Chofardet**: Observations of the Neujmin comet 1914*c*, made at the observatory of Besançon with the *coudé* equatorial. Data given for September 10 and 11. The comet was of the eleventh magnitude, with a small brilliant nucleus and a nebulous tail.—D. **Mirimanoff**: Remarks on a communication of Eugène Fabry. Pointing out an error in a demonstration of Fermat's theorem.—Paul **Lebard**: Remarks on the affinities of the principal genera of the group of ligulate flowers.—P. **Mazé**, M. **Ruot**, and M. **Lemoigne**: Lime chlorosis of green plants. Rôle of the root excretions in the absorption of iron from chalky soils. The presence of excess of chalk in the soil may produce chlorosis by rendering the iron insoluble. The addition of organic acids permitting the solution of small quantities of iron in presence of calcium carbonate removes the chlorosis at once.—Eugène **Pittard**: The comparative analysis of some of the body dimensions in Tartars of both sexes.—Ch. **Dhéré** and L. **Ryncki**: The absorption of visible and ultra-violet rays by carotinoid pigments.

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University College, Reading. Twenty-first Anniversary, Michaelmas Day, 1913. Pp. 88. (Reading.)

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. ii., Part 8. (Sydney: Government of the State of New South Wales.) 2*s*. 6*d*.

Memoirs of the Asiatic Society of Bengal. Vol. iii., No. 6. Some Current Pushtu Folk Stories. By F. H. Malyon. Pp. 355–405. 2*s*. 3*d*. Vol. iii., No. 7. The Chank Bangle Industry. By J. Hornell. Pp. 407–488. 2*s*. 8*d*. (Calcutta: Asiatic Society.)

Social Welfare in New Zealand. By H. H. Lusk. Pp. viii+287. (London: W. Heinemann.) 6*s*. net.

Switchgear and the Control of Electric Light and Power Circuits. By A. G. Collis. Pp. 85. (London: Constable and Co., Ltd.) 1*s*. net.

Inductive *versus* Deductive Methods of Teaching: an Experimental Research. By W. H. Winch. Pp. 146. (Baltimore, Md., U.S.A.: Warwick and York, Inc.) 1.25 dollars.

How I Kept my Baby Well. By Anna G. Noyes. Pp. 193. (Baltimore, Md., U.S.A.: Warwick and York, Inc.) 1.25 dollars.

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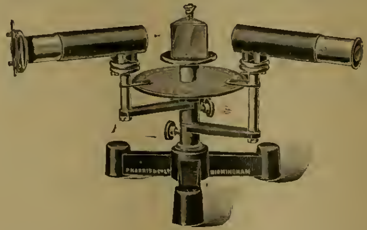

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds far aye."—WORDSWORTH.

No. 2294, Vol. 92] THURSDAY, OCTOBER 16, 1913 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, OCTOBER 16, 1913.

BRITISH FISH PARASITES.

The British Parasitic Copepoda. By Dr. Thomas Scott and Andrew Scott. Vol. i. Pp. x+256. Vol. ii. Pp. xii+72 plates. (London: The Ray Society; Dulau and Co., Ltd., 1913.) Price 15*s.* net.

DR. THOMAS SCOTT has long been recognised as a leading authority on the smaller crustacea of the British seas, and his son, Mr. Andrew Scott, has also made important contributions to our knowledge of the same subject. It is fortunate, therefore, that the Ray Society has found these experienced investigators ready to undertake the preparation of a monograph on the British parasitic Copepoda, of which these two volumes, dealing with the species parasitic on fishes, form the first instalment.

The parasitic Copepoda have hitherto been somewhat neglected from a systematic and faunistic point of view. The student wishing to identify British specimens of fish-lice has had little to help him beyond Baird's "British Entomostraca," published by the Ray Society so long ago as 1850. The inadequacy of this help is shown by the fact that only thirty-four species of fish-parasites are described in Baird's volume, while the authors of the present monograph are able to record no fewer than one hundred and thirteen. The practical importance of a knowledge of the parasites of fishes in connection with fishery research hardly needs to be pointed out, and the careful descriptions and abundant illustrations now provided will prove a most useful foundation for future work in this department.

The authors have not attempted to deal seriously with the morphology and classification of the animals that they describe. For this course they can plead plenty of precedents, and it will meet with little condemnation from those zoologists of the younger generation who are so ready to proclaim the vanity of morphological research. It is likely, however, to cause the student some trouble when he finds, for instance, the term "fifth pair of thoracic feet" applied, in one family, to the appendages of the pre-genital somite, and transferred in the next family, without explanation or discussion, to those of the genital somite.

There are a number of minor blemishes throughout the work that might have been removed by more careful editing; specific names appearing for the first time are sometimes followed by the indication "sp. nov.," as on p. 202, sometimes not, as on p. 135; there is a lack of uniformity in the way in which references are made to the list of literature at the end of vol. i., and some of the references are obviously wrong; and the generic name *Phyllothyreus* appears on p. 92 and elsewhere as *Phyllothreus*. The colouring of some of the plates is very diagrammatic, and adds neither to their beauty nor their usefulness.

From a faunistic point of view, however, the work is of the highest importance, and it is to be hoped that it will attract other students to the many complex problems presented by the life-histories and bionomics of these strangely-modified parasites.

DISEASE AND ITS PREVENTION.

(1) *Prevention and Control of Disease.* By Prof. F. Ramaley and Dr. C. E. Giffin. Pp. 386. (Boulder, Colo.: The University, 1913.)

(2) *Practical Bacteriology, Microbiology and Serum Therapy (Medical and Veterinary).* A Text-book for Laboratory Use. By Dr. A. Besson. Translated and adapted from the fifth French edition by Prof. H. J. Hutchens, D.S.O. Pp. xxx+892. (London: Longmans, Green and Co., 1913.) Price 36*s.* net.

(3) *A Monograph on Johne's Disease (Enteritis Chronica Pseudotuberculosa Bovis).* By F. W. Twort and G. L. Y. Ingram. Pp. xi+179+ix plates. (London: Baillière, Tindall and Cox, 1913.) Price 6*s.* net.

(1) THE authors of this book have undertaken the task of describing, in language intelligible to the educated man without special medical training, the present state of knowledge and opinion respecting the origin, nature, and methods of preventing important diseases. In the earlier chapters the principles of bacteriology and the meaning of terms employed in describing the phenomena of immunity are detailed and explained. In later chapters most of the common diseases are passed in review and the duty of an intelligent citizen in the presence of any such disease succinctly stated.

The vastness of the field attempted to be covered and the necessity of avoiding technical discussion in a work of this kind must needs result in portions of it appearing incomplete to a specialist reader. Thus the student of hereditary influences might doubt whether the authors sufficiently recognise the importance of the soil in the genesis of disease, while the statistician will feel that the face value of various sets of figures quoted differs from their intrinsic worth. Such criticisms as these, however, could be directed against any similar book, and we have no doubt that the present work will satisfactorily achieve the aim its authors had in view. Some suggestions for the improvement of future editions may not be out of place.

Vital statistics necessarily form the principal medium through which the layman acquires a knowledge of the prevalence of disease. The remarks on pp. 8-9 might be amplified with advantage. In particular the methods by which corrections for the age and sex constitutions of different populations are made can be readily explained to an intelligent reader, and such an explanation would enable him to avoid many fallacies in comparing mortality rates.

(2) This translation of Besson's well-known treatise forms a notable addition to the list of text-books on bacteriology available to the English student and laboratory worker, and we may say at the outset that Prof. Hutchens has admirably performed the undoubtedly difficult task of translating and emendating a foreign text-book in such a manner as to render it palatable to the English reader. The translator, while adhering closely to the French text, has wisely decided to reproduce the sense rather than the letter of the original, with the result that the text betrays little or no sign of its foreign origin. The present translation has been made from the last French edition, which appeared in 1911, and consequently numerous additions have been made by the translator so as to bring the matter up to date. The most extensive of these additions are the chapters embodying recent work on the relationships of the Gaertner-Paratyphoid group of bacilli, to which subject English writers have made important contributions, also on the work of the English Royal Commission on Tuberculosis, in which Prof. Hutchens formerly participated. The chapter on the microscope has also been entirely rewritten and contains a most complete account of the working of the modern microscope, including the principle of dark-ground illumination and its practical applications.

Besides these major additions to the French original, there is scarcely a page of the text which does not bear evidence of the work of the emendator. This generally takes the form of bracketed paragraphs or footnotes, which the translator has interpolated where the views of the French author, or the French school generally, happen to conflict with current English or German opinion. By the advanced laboratory worker these interpolations will be readily appreciated, but it is possible that the student may become bewildered by the multiplicity of these interpolations, which not infrequently contain opinions at variance with those of the French author. Short of rewriting the whole book, however, such defects are, of course, inevitable, and it is to be hoped that the translator, with the experience he has now gained, may see his way to compile an equally comprehensive and purely English text-book, in which greater scope for the exercise of criticism would be available than is possible in a work written at second hand. It is doubtful whether the French original was really the best foundation on which to build an English text-book. The English mind is essentially practical, and there is no doubt that many of the methods so minutely described by the French author and many of the complicated media recommended for the isolation of various micro-organisms are either antiquated, superfluous, or unworthy of mention. The arrangement of the matter in the book may justly be considered a model, and the prominent headings of the various sections are most helpful to the reader.

The book is well bound and beautifully printed, and the illustrations are excellent. The only important misprint we have noticed is the curious but consistent employment of "an" before such words as "homogeneous," "herd," and "horse."

As a most comprehensive treatise on bacteriology, we can confidently assert that Dr. Besson's book in its English dress has unique claims on English workers in bacteriology.

(3) The great merit of this monograph rests on the important contributions which the authors have made during the past four years to our knowledge of the etiology of Johne's disease.

This disease is one which affects cattle (and possibly also sheep and goats) in various countries, and it is only recently that serious attention has been directed to it in Great Britain. The chief pathological lesion in affected cattle is an irregular thickening of the bowel, generally in the neighbourhood of the ileo-cæcal valve, and the symptoms to which this lesion gives rise are chiefly diarrhœa and extreme emaciation. The disease leads to serious economic loss, and the name by which it goes in this country is that of Prof. Johne, of Dresden, who in 1895, in conjunction with Dr. Frothingham, first directed attention to the presence of acid-fast bacilli in the thickened intestine. For many years all attempts to cultivate these acid-fast organisms on artificial media either failed entirely or the cultures that were obtained from the lesions proved to be incapable of reproducing the disease in experimental animals. In 1910 Dr. Twort and Mr. Ingram started an investigation of this question and ultimately succeeded in obtaining a growth of the organism on an egg-medium in which killed tubercle bacilli were incorporated. Later it was found that the addition of killed Timothy grass bacilli, or glycerine extracts of these bacilli, gave equally good results.

These experiments have been repeated and confirmed by other workers.

Further, attempts to reproduce the disease by inoculation of artificial cultures have been successful. The authors have also carried out a considerable number of experiments with the view of obtaining a preparation of Johne's bacillus suitable for diagnostic purposes on the same lines as those on which the tuberculin test is at present applied. The results have been distinctly encouraging, and we may express the hope that lack of funds may not impede the further effective prosecution of the author's researches. The book has been very carefully written throughout, and concludes with a valuable bibliography. To all scientific veterinarians and stockbreeders this monograph may be heartily recommended.

MATHEMATICAL TEXT-BOOKS.

(1) *Elementary Algebra.* By C. Godfrey and A. W. Siddons. Vol. ii. Pp. xi+227–530+xlvi. (Cambridge University Press, 1913.) Price 2*s.* 6*d.*

(2) *Four-Figure Tables.* By C. Godfrey and A. W. Siddons. Pp. 40. (Cambridge University Press, 1913.) Price 9*d.* net.

(3) *Papers Set in the Mathematical Tripos, Part I., in the University of Cambridge,* 1908–1912. Pp. 70. (Cambridge University Press, 1913.) Price 2*s.* 6*d.* net.

(4) *Elementary Experimental Dynamics for Schools.* By C. E. Ashford. Pp. viii+246. (Cambridge University Press, 1913.) Price 4*s.*

(5) *Mathematics, Science, and Drawing for the Preliminary Technical Course.* By L. J. Castle. Pp. vii+149. (London: George Routledge and Sons, Ltd., 1913.) Price 1*s.* net.

(6) *Nomography, or the Graphic Representation of Formulae.* By Captain R. K. Hezlet. Pp. iv+54. (Woolwich: Royal Artillery Institution, 1913.) Price 2*s.* 6*d.*

(7) *The Principles of Projective Geometry Applied to the Straight Line and Conic.* By J. L. S. Hatton. Pp. x+366. (Cambridge University Press, 1913.) Price 10*s.* 6*d.*

(1) THE second volume of this treatise, which is intended to include as much as the pupil of average ability will assimilate in a full school course, opens with a treatment of indices and logarithms. The next two chapters deal with variation of functions of one or more variables. This is followed by harder equations, surds, proportion, and progressions. The next four chapters contain an excellent introduction to the differential and integral calculus. Although confining themselves to very simple functions, x^2, x^3, $1/x$, the authors have illustrated all the important ideas of the subject. The educational value of such work as this is very great, and we have little doubt that in a few years' time it will be accepted as a regular part of the non-specialist course. This and the chapter on progressions are the outstanding features of a book which is admirable throughout. An appendix is added containing such parts of the subject as are still required by various conservative examining bodies, but which the authors hope further reform will soon render unnecessary. There is an excellent set of test papers.

(2) We welcome the issue of this set of four-figure tables chiefly on account of their low price. Now that their use has become so general, it is important that students should be able to procure them in an inexpensive form. There is little to note in regard to their contents, which include, in addition to squares, square-roots, reciprocals and logarithms, the usual trigonometrical tables. In our opinion it is unfortunate that the table of logarithms is not placed at the beginning. Coming as it does at p. 22, some time will always be lost in finding it. The arrangement of the table of square-roots is new and distinctly ingenious; for instance, opposite to 42, printed one below the other are the numbers 2049, 6481, thus making it impossible for the pupil to take the square-root from the wrong page.

(3) This collection of papers, set under the new regulations for the first part of the mathematical tripos, besides being of use to undergraduates at Cambridge, is interesting as showing the change in character of the work required from candidates for honours since the abolition of the order of merit. The ten-minute conundrum has now practically disappeared, and its place taken by more practical and straightforward questions. With the exception of some electricity and optics, there is practically nothing that the capable specialist would not be able to do on leaving school, and the course, therefore, suits not only those who are intending to take up research work, but also those who will afterwards turn to mechanical science, engineering, or physics.

(4) The use of a trolley and inclined plane has done much to smooth away the difficulties from the path of those who attempt an experimental introduction to dynamics. Most teachers now agree that it is unsatisfactory to allow the ordinary student to confine himself to a theoretical treatment. Mr. Ashford quotes from Thomson and Tait's standard treatise a remark that "Nothing can be more fatal to progress than a too confident reliance on mathematical symbols, for the student is only too apt to consider the *formula*, and not the *fact*, as the physical reality." And he has set

himself the task of devising a course which should guard the student against this danger. Illustrations are drawn from practical engineering, steamships, aëroplanes, motor-bicycles, turbines, &c., which should convince the reader of the real utility of mechanics, and arouse and preserve his interest. Text-books such as this do much to advance the cause of elementary mathematical education by enlarging the mental horizon of the student, and giving him a sound knowledge of the fundamental ideas, such as mass, force, energy, momentum, &c., without which any substantial progress is impossible.

(5) This course of practical arithmetic, geometry, and mechanics is written for first-year students taking a technical course, and is intended to occupy rather more than a hundred hours. The first forty pages deal with fractions, decimals, ratio, percentagé, and graphs; the next sixty with the mensuration of the triangle, circle, and simple solids; and the remainder with the principle of the lever, centre of gravity, and the measurement of work. The examples are numerous, simple, and practical.

(6) This small pamphlet gives an account of a graphical method for facilitating numerical calculations required in connection with comparatively complicated formulæ occurring in scientific and engineering work. Although disclaiming any originality for the methods he gives, the author points out that as yet they have received little or no attention from English writers. The theory is not difficult, but those whose mathematical knowledge is small will find it easy to master the practical procedure if they study the examples which are worked out in great detail, although they may consider the nomenclature rather alarming.

(7) There are few subjects which depend so much on the personality of the teacher for their success, and the interest they arouse in the student, as geometry. And this applies even more to its higher branches than to the elements. A carefully-chosen course on projection and homography not only stimulates the mind of the pupil by the power and generality of its root ideas, but also induces an enthusiasm which ensures a remarkable rapidity of progress. There are two distinct methods of procedure open to the teacher. On one hand, he may base his work on an analytical foundation, thus making use from the start of imaginary and ideal elements, and so establishing the validity of general projection and the principle of continuity. Properties of homography and involution, and the idea of a one-to-one correspondence, also admit of valuable illustrations from analysis. Or, on the other hand, he may restrict himself to the methods of pure geometry, and exclude imaginary elements until, at an advanced stage, they emerge from the consideration of an overlapping involution. In the treatise before us the author has adopted the latter method, which we are inclined to think is rather more difficult for the ordinary student. Its contents form a very comprehensive account of the projective geometry of lines and conics up to the standard of a university honours degree. The author writes clearly, and has brought together an extremely interesting collection of properties; the excellence of the diagrams calls for special notice. We do not hesitate to say that those who use this book will gain a sound knowledge and appreciation of the principles of higher pure geometry.

OUR BOOKSHELF.

The Climate and Weather of San Diego, California. By F. A. Carpenter. Pp. xii+118+plates. (San Diego: Chamber of Commerce, 1913.)

An excellent little book on the climate and weather of San Diego, South California, has been prepared by the local officer of the weather bureau, and published by the local chamber of commerce. The book contains twenty-seven short chapters dealing partly with San Diego town and bay, partly with San Diego county, and partly with general factors in weather and climate.

The characteristic feature of the climate is the "velo" cloud, to which the place owes its comparatively low summer temperature, in spite of its proximity to the tropics. (The latitude and longitude might with advantage have found a place at the beginning of the book.) The "velo" cloud is a cloud of a low stratus type, which "veils" the sun in the morning, and usually disappears with the coming of the sea breeze in the afternoon.

On the average the sun shines on 356 days of the year at San Diego, and the total rainfall is under 10 inches; at times, therefore, rain is earnestly desired, but we are told in illustration of the importance of local signs in weather-forecasting that San Diego's best-loved priest used to refuse to offer prayers for rain unless the wind had been in the south for three days. The book is eminently readable, and the statistical tables have been infused with a human interest. E. G.

Petrographische Untersuchungen an Gesteinen des Polzengebietes in Nord-Böhmen. By K. H. Scheumann. Pp. vi+607–776. (Leipzig: B. G. Teubner, 1913.) Price 8 marks.

The latest number of the *Abhandlungen* of the *Königl. Sächsischen Gesellschaft der Wissenschaften* contains a memoir by K. H. Scheumann on the Tertiary igneous rocks of the Polzen district, in northern Bohemia. These rocks are of the same age as those of the better-known Mittelgebirge, farther west, and have the same alkaline affinities, though there is not the same great preponderance of basic types. In the neighbourhood of Leipa occur numerous volcanic plugs and necks, composed of various alkaline basalts and trachydolerites, with tuffs of corresponding nature. In addition, dykes with a N.E.–S.W. direction are met with throughout the whole district. These have a wider petrographical range, and are discussed at length by the author. The most basic rocks of this series contain 50 per cent. of olivine, with melilite, biotite, haüyne, nepheline, &c. To this type the author gives the name *polzenite*, but it does not seem to differ essentially from alnöite. From this extreme the rocks range through melilite- and nepheline-basalts, haüyne-basalts, and various trachydolerites to phonolites, the most acid term being a trachytoid phonolite very rich in sanidine. The silica percentage ranges from less than 30 to 58. The whole assemblage of dyke-rocks is regarded as a single series, derived from a common magma by differentiation along definite lines. This conclusion is enforced by chemical analyses, fourteen in number, which yield smooth curves when plotted on a diagram. The author connects the differentiation with progressive crystallisation in the original magma, of trachydoleritic composition; and for a series of rock-types so related he proposes the term *pexitropic*.

Elements of Water Bacteriology with Special Reference to Sanitary Water Analysis. By S. C. Prescott and C. E. A. Winslow. Pp. xiv+318. Third edition. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 7*s*. 6*d*. net.

Attention has been directed in these columns to the previous editions of this work; to the first on July 7, 1904 (vol. lxx., p. 221), and to the second on November 5, 1908 (vol. lxxix., p. 6). In view of the important progress made during the last five years in sanitary bacteriology, the authors have thoroughly revised their work. Newer ideas on the effect of temperature upon the viability of bacteria in water are included; the recent recommendations of the committee on standard methods are discussed; the description of the isolation of specific pathogenes from water has been largely rewritten and much extended; and a new chapter on the application of bacteriology to the sanitary study of shellfish has been introduced.

Metallography. By Dr. Cecil H. Desch. Pp. xi+431. Second edition. (London: Longmans, Green and Co., 1913.) Price 9*s*.

The first edition of this book was reviewed in the issue of Nature for January 5, 1911 (vol. lxxxv., p. 301). In the present work the general plan and arrangement of the first edition remain unchanged, but the text has been revised, and the most important results of recent investigations have been incorporated. Important changes have been made in the treatment of the physical properties of alloys, and of the metallography of iron and steel.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Piltdown Skull and Brain Cast.

The discovery of the fragments of the Piltdown skull has given rise to a problem of a new kind. In all former discoveries of the remains of ancient man the part of the skull actually found was intact, or, if broken, a sufficient number of pieces were recovered to render reconstruction an easy task. In the case of the Piltdown skull, although the greater part of the bony walls of the cranial cavity were found, a large area of the forehead and along the middle line of the roof of the skull are still missing. The problem that has to be solved is: How much is missing? The solution of the problem, as Dr. Smith Woodward realised when he commenced his work of

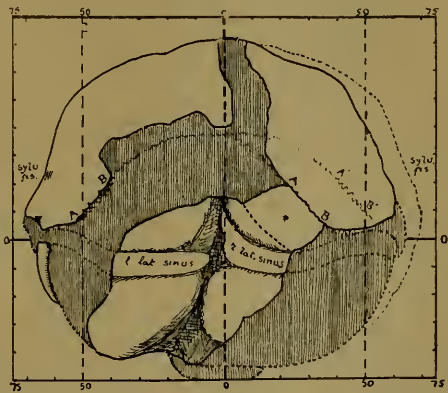

Fig. 1.—Occipital aspect of the brain-cast of the Piltdown skull as reconstructed by Dr. Smith Woodward. The parts missing in the skull are represented by vertical shading.

restoration, lies in the hinder or occipital wall of the skull. The fragment which Dr. Smith Woodward himself discovered gives a definite index to the width of the right half of the occipital bone, and also to the width of the hinder or occipital part of the head.

It is clear, then, that the first step in the reconstruction of the Piltdown skull must be an accurate adjustment of the parts which enter into the formation of the occipital wall. If a mistake is made in this initial step, then the error may become proportionately greater as one proceeds towards the region of the forehead. In my opinion, Dr. Smith Woodward has made a grave mistake in his restoration of the occipital region, and therefore the brain cast which he obtained from his reconstruction—the basis of Prof. Elliot Smith's preliminary note to the Geological Society—does not give an accurate representation of either the size or general form of the brain of Piltdown Man.

The nature of the problem and the manner of its solution will be made clear by the three accompanying figures. Fig. 1 represents the occipital aspect of the brain cast obtained in Dr. Smith Woodward's reconstruction; Fig. 2, the same view in a reconstruction of the skull made by the writer: Fig. 3, the same view of a brain cast from the skull of an Australian native, with a cubic capacity of 1460 cubic centimetres—rather a large skull for an Australian native. All three brain casts have been arranged on the same horizontal plane and drawn to the same scale. To facilitate comparison, they have been placed within squares of the same size. Three vertical lines are represented—the middle and two lateral lines. The lateral lines are 50 mm. apart from the middle line.

Fig. 2.—The same aspect from the reconstruction of the skull by the writer.

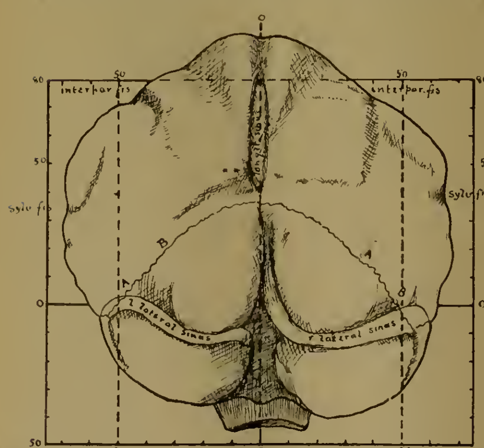

Fig. 3.—The same aspect of the brain cast from the skull of an Australian native—for comparison with figs. 1 and 2.

The leading principle which guides the task of reconstruction is symmetry—the right and left halves of the mammalian head and skull are approximately alike. When the test of symmetry is applied to the occipital region of the brain cast from Dr. Smith Woodward's reconstruction of the skull, it is at once seen that there is a great degree of discrepancy between the right and left halves; the amount which has to be added to the right half to make it approximately equal to the left is shown by the stippled line in Fig. 1. The discrepancy between the two halves is even more marked when the right and left halves of the lambdoid suture—the joint between the posterior margin of the two parietal bones and the occipital—are investigated.

The situation of corresponding parts of this suture are represented on the right and left halves of the recovered parts of the Piltdown skull; Dr. Smith Woodward has already recognised the presence of those two parts of the lambdoid suture. They are indicated on the three accompanying figures as A, B. Now on the left side of the skull the lambdoid suture cuts the lateral line 50 mm. from the mid-line; on the right side it falls 20 mm. short of the lateral line; to make the two sides approximately symmetrical, the right lambdoid suture has to be moved outwards until it occupies the position A′ B′, shown in Fig. 1. That degree of error exceeds even the amount found in human skulls deformed artificially or deformed by disease, and points to an error in reconstruction. It will be also seen that the right and left halves of the suture, as indicated on the brain cast—the discrepancy is even more marked on the reconstruction of the skull—have a different inclination to the mid-line of the reconstruction. It may be thought that all that is necessary to obtain symmetry is to move the parts of the right half outwards until the right and left halves of the brain cast are approximately equal in size; when this is done, it will be found that marked asymmetry of another kind is introduced. In moving one part, all the other parts of the skull are thrown out of place; the task has to be recommenced from the first initial step.

In Fig. 2 I give a drawing of the brain cast obtained when the parts of the skull are placed together according to their structural markings. There can be no doubt as to the middle line of the occipital bone; on its outer surface is clearly seen the ridge which indicates the division between the right and left halves of the neck. We may presume in this primitive man that the neck was symmetrical. The next point which has to be fixed definitely is the middle line on the roof of the skull. At first I accepted the middle line as fixed by Dr. Smith Woodward—an elevation on the outer aspect of the left parietal bone—near its hinder upper angle—corresponding to a wide depression which is to be seen on the inner aspect of that part of the bone. I found it impossible to obtain even an approximate symmetry of the right and left halves of the skull in all my attempts at reconstruction when I proceeded on this basis.

On comparing the corresponding regions of the Piltdown and Neanderthal brain casts, it became quite apparent that the markings of the middle line—which I had accepted from Dr. Smith Woodward—did not represent the middle line, but a region well to the left of that line. The excavation or groove which we had regarded as caused by the longitudinal blood sinus—a channel passing along the roof of the skull under the middle line—was not due to that structure, but to the well-marked elevations of the brain on each side of the longitudinal sinus. These cerebral elevations are clearly marked in the brain casts of Neanderthal man. In the skulls of all the higher primates, the longitudinal sinus, near the hinder end of the adjacent margins of the right and left parietal bones, is marked by a narrow deep groove with distinct edges; on the margin of the upper angle of the Piltdown fragment the edge or margin of this groove can be clearly recognised.

In Dr. Smith Woodward's reconstruction, therefore, it is not only necessary to move the fragments of the right side outwards; the left parietal bone has also to be moved outwards, or rather tilted upwards and outwards until it assumes a more vertical position, with the marking of the sinus in the middle line. When that is done, and the other parts correctly adjusted, the brain cast assumes the form and size represented in Fig. 2. I made many experiments to test other possible suppositions, but only when the fragments were placed as in Fig. 2 could I secure symmetry, and at the same time obtain all the anatomical markings in their normal situations. The brain cast obtained from this reconstruction displaces just over 1500 cubic centimetres of water. Dr. Smith Woodward estimated his brain cast provisionally at 1070 c.c.; the replicas of the brain cast which were distributed displace 1200 c.c. of water; even if the reconstruction carried out by Dr. Smith Woodward is accepted, and the right half is made approximately symmetrical with the left, the brain of Piltdown man will be about 200 c.c. above his original estimate.

In my reconstruction two other peculiar features of the original brain cast have disappeared. One is the sharp bending inwards or kinking of the temporal lobe of the brain; the other is the position of the foramen magnum—the opening in the base of the skull for the exit of the spinal cord. In the original reconstruction the lower margin of the occipital bone was brought forwards so far in the base of the skull that when a palate was articulated there was no room left for the soft palate and pharynx. The corresponding basal parts of the brain cast are, of course, also abbreviated.

I do not attach any high importance to actual brain mass; it is merely a rough indication of mental power when applied to human brains. So far as concerns the description of the actual markings of the Piltdown brain cast given by my friend Prof. Elliot Smith, I am in complete agreement, but so far as concerns general mass and conformation, it is clear, from his letter in Nature, October 2, p. 131, that I am at complete variance. How far I am right—to what extent I have made an error—remains to be seen; but the publication of these drawings and observations will show that I have made every endeavour to arrive as near the truth as is possible for me.

A. Keith.

Royal College of Surgeons, Lincoln's Inn Fields, W.C., October 4.

The Theory of Radiation.

In his letter published in Nature of October 9, Prof. Maclaren has referred to my use of the concept of a natural unit of angular momentum, and perhaps a few explanatory remarks may be useful, as the work has not been published in a journal devoted to physics. The concept first appeared in my paper on the constitution of the solar corona, published in the Monthly Notices of the Royal Astronomical Society in June of last year. It was found that the energy frequency ratios of the atomic systems, which were held to be the origin of the main lines in the coronal spectrum, were always simple multiples of the quantity $h/2\pi$, where h is Planck's constant. As these ratios were nothing more or less than the angular momenta of the atoms, the conclusion was forced upon me that Planck's h could only be an angular momentum.

As was stated at the time, such an interpretation removes much of the difficulty otherwise pertaining to the quanta theory, when expressed in the usual way in terms of energy. It does not, of course, explain that theory, but merely renders it more intelligible as a possibility, for it is not difficult to obtain fair mechanical models of atoms the angular momentum of which can only have a discrete set of values. Prof. Maclaren, in his letter has, in fact, indicated a very beautiful one by the help of the magneton, which has a definite unit of angular momentum. It is evidently possible to construct a system containing multiples of that unit.

The more recent work of Dr. Bohr (*Phil. Mag.*, July and September of this year) applies the same concept to series spectra, but is different in that it postulates the angular momentum of an electron in the normal state of the atom as *exactly* $h/2\pi$. For example, the whole angular momentum of a neutral atom with five electrons is, on Bohr's theory, $5h/2\pi$. But I had found it necessary in the paper cited above that the value should be $25h/2\pi$. There is in this respect a discrepancy between the two theories, which is probably not serious, as Dr. Bohr has only calculated the series lines in hydrogen and in helium with a single electron, and therefore charged. (The number of electrons and its square are then identical.) The real test of his theory will lie in its capacity to account for the *usual* spectrum of helium—a test which does not appear difficult. For Dr. Bohr has concluded that helium will not take a negative charge. The ordinary spectrum must therefore come from the uncharged atom in its passage between stationary states, which are of a limited number, as there are only two electrons. It does not appear that the helium spectrum can be obtained in this way, but perhaps further investigation will modify this conclusion. Until this is done, the point raised by Prof. Fowler in a recent discussion in Nature, as to the apparent need for keeping the Balmer and Pickering spectra of "hydrogen" as two *distinct* series, has not been answered.

But as Prof. Maclaren states, whatever be the fate of this theory, the natural unit of angular momentum seems necessary. It is inevitably suggested by any atomic theory which now attempts to rest on a foundation of electrons and a positive nucleus; for its use is not restricted to the applications already mentioned. It is apparently the only ready means of explaining a type of spectral series which the writer has found recently to be of importance—a series in which the cube roots of the wave-lengths have constant differences.

J. W. Nicholson.

King's College, London.

Science and the Lay Press.

Many "lay" journalists will have welcomed the comments in Nature of October 9 (p. 172) on the "sensational paragraphs to the effect that Sir Frederick Treves had announced at the Radium Institute 'a complete revolution in the future of radium.'" For the undue enthusiasm shown, the Radium Institute is partly to blame. Sir Frederick claimed credit on behalf of it for the discovery that emanation was as valuable as radium in the treatment of cancer, and when Mr. Pinch was describing the good results obtained with emanation water in the treatment of arthritis deformans he interpolated the remark that this was something new in medicine. Undoubtedly, too, the impression was created in the minds of many of those present that by utilising emanation a gram of radium could be made to do the work of several grams. While in the matter of comment several newspapers fell into gross errors, they did little more than translate into popular language the sense of what was said.

Unfortunately in compressing what he had to say

Sir Frederick Treves did not find it possible to show clearly in what exact respects the institute claimed to have made an advance. I imagine his remarks were intended to serve a double purpose—to explain the part that radium can play in disease and to show on what lines the institute had new information to publish.

The conditions of lay journalism are such that the reporter is usually forced to estimate the value of claims put forward by considering the way in which they are presented, coupled with the standing of the speaker and of the institution that has given him a platform. Several papers have made the experiment of employing an expert in such matters, but on the whole the results have been disappointing. It is to be hoped that the episode, and your comments on it, will act as a warning for future occasions, and that in communications to the lay Press men of science will be more careful to preserve a proper perspective and to differentiate clearly between new and already well-known facts.

ONE OF THE REPORTERS PRESENT.

THE GLASGOW MEMORIAL TO LORD KELVIN.

IN May, 1908, in response to a widely expressed opinion that a memorial should be erected to Lord Kelvin, a meeting was called by the Lord Provost of Glasgow to consider the matter. This gathering, representative of the city and west of Scotland, resolved to mark in a fitting and permanent form its sense of the manifold benefits which Lord Kelvin's researches and discoveries in physical science, and his patient application of the same to the common uses of man by sea and land, have conferred upon the world, by establishing a worthy memorial of him in the city where he lived and laboured.

The desire thus expressed was amply accomplished on Wednesday, October 8, in the presence of a large and distinguished assemblage, including many veterans of science trained under Lord Kelvin, and leaders in other departments of life, when the unveiling of the memorial statue was performed by the Rt. Hon. Augustine Birrell, K.C., M.P., Lord Rector of Glasgow University. The statue stands in Kelvingrove Park, at the base of the hill on which the University is built, facing S.E. towards the river Kelvin and the city. It represents Lord Kelvin seated with his familiar green book and pencil in hand, in a characteristic attitude as when at work on some problem. Behind the figure are placed his binnacle and mirror galvanometer, with other emblems of his services to industry and science. The memorial is the work of Mr. A. McFarlane Shannan, Glasgow, and, in the words of Prof. Perry, as a faithful likeness and, what is more, as a work of art, it does all that art could do in awakening the emotions of reverence and love felt by all who came closely in touch with the great master.

At the unveiling ceremony, which took place at 11 a.m., a letter from Lady Kelvin was read expressing her regret at being unable to attend, and after a short introductory speech by the Lord Provost, Mr. Birrell began his address. He referred to William Thomson's early life and training in Glasgow, and traced his close and

Clay Model of Statue of Lord Kelvin in Kelvingrove Park, Glasgow. Sculptor, Mr. A. McF. Shannan.

life-long connection with the University, beginning as student, and ending its first stage as the author of original memoirs at the age of eighteen. Then came the eventful interlude at Cambridge, and Mr. Birrell genially recalled how Thomson's originality proved his undoing in the competition for the Senior Wranglership, and how "the ancient and eternal wrongs of the examination room" were mitigated later when Parkinson, despite his pace, was second Smith's Prizeman. Cambridge over, he returned to Glasgow to the professorship of natural philosophy, "a chair which he occupied and illuminated for half a century." In closing the review of Lord Kelvin's work in Glasgow as student, as investigator, and teacher, the Lord Rector added that he had said enough, and far more than was necessary, to prove that before all other cities, and above all other places, Glasgow is the city and the place for a statue of Lord Kelvin. Men like Lord Kelvin were seldom solitary voyagers, but rather leaders of a great company of thinkers and experimenters labouring to lighten the burden of suffering humanity. As a practical inventor as well as a thinker his claims appealed to all, and would continue to do so. It was therefore with pride and joy and confidence that he asked the City of Glasgow, for all time to come, to take good care of a beautiful memorial of a truly memorable man.

Principal Sir Donald MacAlister, in moving a vote of thanks to Mr. Birrell, said that the Lord Rector had performed the ceremony with his accustomed felicity, and had worthily expressed the homage of the city and University to one of its brightest ornaments. In the name of the subscribers, Prof. S. P. Thompson moved a vote of thanks to the sculptor; this was seconded by Prof. Perry, and Mr. Shannan replied.

At the luncheon following on the unveiling of the statue to Lord Kelvin the toast, "The Memory of Lord Kelvin," was proposed by the Rt. Hon. Arthur James Balfour, M.P.

Mr. Balfour dwelt upon Lord Kelvin's happy combination of great gifts, making him at once the greatest master of theory and a leading spirit in every department of practical affairs. His services to mankind, as man of business, inventor, teacher, investigator of the great problems of the universe, in order more and more to raise the material condition of mankind, rank him as greatest of the great group of physicists who have paved the way for the scientific revolution in the midst of which we are living. Lord Kelvin's want of sympathy with those latter-day speculations to which his own labours led up was not the imperviousness to ideas which comes of mental inertia. But what he would accept from other men depended at the moment upon the intense inner life that he led, which concentrated his attention upon certain lines of investigation, and made him almost oblivious of what was going on outside the current of his own thought. Great in knowledge, great in achievement, yet in himself the most modest, the most eager, the most childlike—in the good sense of the word—of men, his record had never been surpassed in the whole annals of physical science.

THE PREHISTORIC SOCIETY OF EAST ANGLIA.

The members of the Prehistoric Society of East Anglia are to be congratulated on the systematic manner in which they are studying the properties of flint, with special reference to the identification of human workmanship. In the latest part of their proceedings[1] Dr. W. Allen Sturge discussess the patina of flint implements, and concludes that it is produced entirely by exposure on the surface. Permanent burial appears not only to retard, but even to prevent, patination. Mr. J. Reid Moir describes some experiments on the chipping of flints, and attempts to show that the flaking of a margin by natural causes is comparatively irregular, while the blows directed by man to produce such flaking are at definite angles with much regularity. He also demonstrates that flakes produced by natural pressure often exhibit a bulb at each end. Mr. F. N. Haward follows with additional notes on the chipping of flints by natural agencies, and concludes that much can be accounted for by movements in the ground. He instances particularly the chipping due to the creeping motion of gravel at the top of pipes in the chalk.

[1] Proceedings of the Prehistoric Society of East Anglia, 1910–11, 1911–12, vol. i., pt. ii. (London: H. K. Lewis, 1912.)

Among descriptive papers may be specially mentioned that by Mr. J. Reid Moir on the much-discussed human skeleton discovered by him in a glacial deposit at Ipswich. Though interesting, it is by no means convincing in its argument that the skeleton lay in undisturbed ground; and the difficulty in believing that the human being in question lived before the deposition of the boulder clay is further enhanced by the report of Prof. A. Keith, who finds that there is no essential difference between this skeleton and that of a modern civilised man.

There may also be differences of opinion about the supposed flint implements, described by Mr. W. G. Clarke, from the basement bed of the Norwich Crag, in Norfolk; but Dr. Sturge's elaborate paper on Mousterian and other late Palæolithic flint implements from superficial deposits in East Anglia will be accepted without hesitation, and is all the more welcome from the abundance of French specimens which the author is able to select for comparison from his own cabinet. All the papers are well illustrated, but this one by Dr. Sturge especially so; and the only fault we have to find with them is their frequent diffuseness. A more concise and systematic mode of expression might be adopted in future with advantage.

NOTES.

An extra meeting of the Chemical Society will be held at Burlington House, Piccadilly, W., on Thursday, October 23, at 8.30 p.m., when the Ladenburg Memorial Lecture will be delivered by Prof. F. Stanley Kipping, F.R.S.

A lecture will be given under the auspices of the Swedenborg Society at the rooms of the Society of British Artists, Suffolk Street, on the evening of November 19, by Prof. W. B. Bottomley, of King's College, London, on Swedenborg's doctrine of the origin of life. Sir W. F. Barrett, F.R.S., will occupy the chair.

The High Commissioner of the Federated Malay States has notified that, in consideration of the importance of the London School of Tropical Medicine to the Government, a sum of 5000*l.* has been voted as a contribution to Mr. Austen Chamberlain's appeal for 100,000*l.* for the endowment of the school. The grant was made by the Legislative Council on the representation of unofficial members. Mr. Chamberlain's fund now amounts to 70,000*l*.

A discovery of arctic land, which, when further investigated, will add an important feature to even a small-scale map of the north polar region, is reported by *The Times* correspondent in St. Petersburg. It appears that Capt. Wilkitsky, in command of two Russian surveying ships off the north Siberian coast, has been working northward and westward from Vladivostok and Cape Dezhnev, and was brought to a stop by ice off Cape Chelyuskin. Proceeding northward in an attempt to turn the barrier, he came upon land—an eastward-facing coast—extending in a direction roughly north-north-west from 78° to 81° N., over a distance of 200 nautical miles. He was forced to return, and has sent his message from Fort St. Michael, in Alaska. The existence of land of such extent as is indicated at once suggests an interruption in the polar circulation, goes far to account for the habitually ice-bound condition of the Kara Sea to the south-west, and of the waters off Cape Chelyuskin itself (which must apparently be separated from the new land by a strait only some forty miles wide), and may be taken to bear upon the distinct northerly trend of the drift of Nansen's ship, the *Fram*, which appears in the charts between lats. 110° and 90° E. If the new land really terminates in 81° N., it may be added that the *Fram* easily missed it, being fully three degrees more northerly.

Mr. Truman H. Aldrich, of Birmingham, Alabama, has presented his entire collection of recent shells, about 20,000 named species, to the museum of the Geological Survey of Alabama. The series includes not only Mr. Aldrich's gatherings and the results of exchanges during more than fifty years, but several large private accumulations which were purchased entire, notably the Pike Mauritius series, the Jones Bermuda and Nova Scotia shells, and the Parker cabinet of about 5500 listed species. The Aldrich collection is particularly rich in operculate land shells and includes many types. About 1500 books, conchological and other scientific works, accompanied the gift. Mr. Aldrich has already proved himself a generous friend of the museum. Three years ago he gave all his duplicate shells, some 250,000, fine specimens; and the very rich set of Tertiary invertebrate fossils is largely due to him. His cabinet set of these fossils, one of the finest in the world, was acquired by the Johns Hopkins University of Baltimore.

A striking and impressive instance of the benefits conferred upon the human race by developments of modern science was provided by the occurrences in connection with the disastrous fire which destroyed the British steamship *Volturno* in mid-Atlantic last week during a heavy gale. The passengers and crew numbered 657, and it is known that 521 have been saved. All the survivors on board the ship when the vessels arrived which responded to the *Volturno's* wireless telegraphic call for help were saved. The Cunard liner *Carmania* received the first news of the fire, and immediately use was made of her wireless installation to send the cry for help far and wide, with the result that ten steamships were able to render aid. The 521 survivors thus owe their lives primarily to wireless telegraphy. Among the rescuing vessels was an oil-tank steamer, the *Narragansett*, which by discharging two large streams of oil, moderated the troubled waters and assisted in the work of rescue by enabling small boats to approach the burning vessel with less danger. A passenger on board the *Carmania* says, in *The Daily Mail*, that within five minutes after the commencement of the discharge of the oil, the sea for a hundred yards away from the *Narragansett* and towards the *Volturno* became absolutely calm, apart from a slight roll.

The death is announced, in his seventy-eighth year, of a distinguished American astronomer, Rear-Admiral John R. Eastman. In his boyhood he lived on a farm in New Hampshire, and attended only a public elementary school, afterward supporting himself by teaching until he entered Dartmouth College, where he graduated in 1862. After serving for a few years as an assistant at the U.S. Naval Observatory, he was appointed in 1865 professor of mathematics in the U.S. Navy. He retired in 1898 with the rank of captain, and was promoted in 1906 to that of rear-admiral. He was engaged for many years in astronomical observation and research, the bulk of his published work appearing in the annual volumes of the Government Observatory. He prepared and edited the Second Washington Star Catalogue, containing the results of nearly 80,000 observations at the Naval Observatory. He was the author of "Transit Circle Observations of the Sun, Moon, Planets, and Comets," published in 1903. Rear-Admiral Eastman was the first president of the Washington Academy of Sciences.

The death is announced of Sir John Batty Tuke, formerly M.P. for Edinburgh and St. Andrews Universities, at seventy-eight years of age. From an obituary notice in Tuesday's *Times* we learn that Sir John Tuke was educated at Edinburgh Academy and University. On taking the degree of M.D. he went out to New Zealand, where he was civil practitioner in medical charge of a wing of the 65th Regiment. On returning to Scotland in 1863 he began practice in Edinburgh. For some time he was assistant physician at the Royal Edinburgh Lunatic Asylum, and in 1867 was appointed medical superintendent of the Fife and Kinross District Lunatic Asylum. He returned to Edinburgh in 1873, and was associated with the late Dr. Smith and Dr. Lowe in the management of Saughton Hall Asylum, which he continued to direct until a few years ago. He was president of the Medico-Chirurgical Society and of the Neurological Society of the United Kingdom. He held the honorary degrees of D.Sc. (Dublin), LL.D. (Edinburgh), and LL.D. (St. Andrews). In 1895 Tuke was elected president of the Royal College of Physicians, Edinburgh, and in 1898, his last year of office, received the honour of knighthood. Two years later he succeeded the late Sir William Priestley as member of Parliament for Edinburgh and St. Andrews Universities. He retired from Parliament in 1910, and was succeeded by Sir Robert B. Finlay. Sir

John Batty Tuke will long be remembered as a great authority on the care and treatment of the insane. He gave himself to work hard at the problems which these cases present; and he deserved, and attained, a very high place in his profession, not only by his practice, but by his writings.

The Right Hon. James Stuart, formerly professor of mechanism and applied mechanics in the University of Cambridge, died on Sunday, October 12, in his seventy-first year. Mr. Stuart's early education was partly private and partly at the Madras College, St. Andrews. Thence he proceeded to the University of that city, where he graduated in 1861, and in the following year he won a minor scholarship at Trinity College, Cambridge. In 1864 he was elected to a foundation scholarship at Trinity, where in 1866 he graduated as Third Wrangler. He was elected a fellow of his college in 1867. The University Extension movement sprang from Mr. Stuart's interest in the education of women. He undertook in 1867 to deliver a course of lectures on astronomy to women teachers. The result was a number of invitations to lecture to working-men. By 1871 he had worked out a scheme of extension lectures, and the University of Cambridge was induced to give definite shape to his proposals. To-day something like a thousand courses of lectures are organised annually, and more than a hundred thousand persons benefit by the teaching. In 1875 Stuart was elected the first professor of mechanism and applied mechanics at Cambridge, and was chosen a member of the University Council. During the next ten years his energies were largely devoted to the founding of the mechanical workshops in which his teaching was carried on, and to the establishment of the mechanical science tripos in the University. Prof. Stuart entered the House of Commons in 1885, and was a member of the London County Council for many years. In 1889 his absorption in party politics in London led him to resign his professorial chair at Cambridge, after a successful tenure of fourteen years. In 1909 he was sworn a member of the Privy Council; and in 1898–1901 he was rector of St. Andrews University.

Mr. Percival Marshall is to be congratulated on the success of the fourth biennial *Model Engineer* Exhibition at the Royal Horticultural Hall. Here are collected together not only models of all kinds of professional make, together with their parts and tools suitable for their construction—good and not unduly expensive—but the work of a large band of amateur workers is exhibited also. No better evidence could be afforded of the stimulus which has been given to latent talent by *The Model Engineer*, now issued weekly, which Mr. Marshall was enterprising enough to found fifteen years ago, and also by the numerous societies and clubs which have come into existence, with this newspaper as a medium of communication. The admirable working drawings of models for which *The Model Engineer* has been so well known have had a valuable educational effect; and whether the immediate stimulus has been the desire to make a kite, a hydroplane, some kind of engine, or a wireless set, for the mere enjoyment of the thing or with the hope of obtaining one of the prizes for model work which the paper or the societies or clubs offer is a small matter, the educative process is carried out on attractive lines, and more serious study is encouraged. It is not possible in the available space to refer to individual exhibits of the amateur class, but reference may be made to the "horophone" or wireless receiving set designed for receiving the time signals from the Eiffel Tower or from Norddeich, mainly with the object of commenting on the fact that Greenwich time, now the time-basis of practically the whole civilised world, is sent out daily by Germany and France to Europe and the North Atlantic, while this country sits idly by accepting for its shipping the invaluable aid given freely by its two neighbours.

In connection with the Fourth International Botanical Congress to be held in London in 1915, a preliminary circular has been issued on behalf of the organising committee. The previous congress, held at Brussels in May, 1910, decided, on the invitation of the Royal Society of London, that the next meeting, in 1915, should be held in London. At a general meeting of British botanists, held in London in March, 1912, an organising committee was elected, and subsequently an executive committee. A number of distinguished patrons of botany were also invited to lend their support to the congress. The organising committee consists of three presidents—Sir David Prain, Prof. F. O. Bower, and Prof. A. C. Seward—the following vice-presidents: Prof. I. Bayley Balfour, Mr. W. Bateson, Dr. F. F. Blackman, Sir Francis Darwin, Prof. H. H. Dixon, Mr. G. C. Druce, Prof. J. B. Farmer, Mr. A. D. Hall, Dr. W. B. Hemsley, Dr. R. Kidston, Prof. F. W. Oliver, Mr. R. L. Praeger, Miss E. Sargant, Dr. D. H. Scott, Mr. A. G. Tansley, Prof. S. H. Vines, and Mr. H. W. Wager; and a list of members which is fully representative of British botany. Sir Frank Crisp is treasurer, Dr. A. B. Rendle general secretary, and Dr. Otto Stapf foreign secretary. The congress will meet from May 22 to May 29, 1915, and its work will include the various branches of botanical science, together with certain matters connected with nomenclature and bibliography left over from the previous meeting. The official language of the congress will be English, but any language may be used in the discussions. Member's subscription is fifteen shillings, and ladies accompanying members may attend the meeting and excursions on payment of ten shillings each. Particulars of meetings, discussions, excursions, &c., will be issued later. As it is estimated that the sum of 1000*l.* will be required to defray the expenses of the congress, the executive committee have decided to raise a fund for the purpose, and an appeal has been issued to British botanists and those interested in the science in Great Britain.

The Hull Municipal Museum, under its curator, Mr. T. Sheppard, continues to increase its collections. Recent additions include a fine bronze palstave lately found at Kirkella, the outfit of a Yorkshire clog-sole maker, a curious ancient wooden nut-cracker representing a human head, Saxon bronze brooches discovered at Hornsea, a fine collection of early jewellery and old firearms, while a large series of ethnographical objects from Nigeria, acquired by Mr. M. S. Cockin, has been deposited. The excellent and well-illustrated progress reports issued by the curator might with advantage be studied by other museum authorities as a means of popularising their collections.

The most important contribution to the October issue of *Man* is a paper by Prof. Flinders Petrie describing a series of the earliest perfect tombs discovered at the great cemetery of Tarkhan, forty miles south of Cairo. Two of them date from the time of King Zet, in the middle of the first dynasty. This series of interments was found absolutely undisturbed, and contained burials of the contracted form, the head lying north, the face east, on the left side, and accompanied by some small pottery and gazelle bones. In the tomb walls are two slits, through which it was believed that the food offerings reached the dead. Some 600 skeletons have been unearthed, those of the females being homogeneous, while the males fall into two groups, indicating that from prehistoric times there had been a slow intermixture of the dynastic race with the indigenous peoples.

Since 1911 the Cambrian Archæological Society has been engaged on the excavation of a Roman fortress in Mid Wales—Castell Collen, "the fortress of the hazel trees," close to Llandrindrod Wells. So far, a granary, the principia or headquarters building, and the house of the commandant have been unearthed. The place, from the evidence of coins and pottery, seems to have been occupied from the end of the first century to the close of the third century A.D. Among the discoveries are a bronze scabbard-scape of late Celtic work, a dolphin-shaped scabbard attachment of bronze, a silver ring with the motto "Amor Dvlcis," and an intaglio with a Roman horseman riding down a barbarian. Much work remains to be done, and contributions are invited by Mr. C. Venables Llewelyn, Llysdinain Hall, Newbridge-on-Wye.

The first report of the Eugenics Record Office of Cold Spring Harbour, Long Island, New York, was issued in June last by the superintendent, Mr. H. H. Laughlin. It contains an interesting account of the way in which the work of the office is organised, and of the elaborate card system which has been adopted for indexing the extensive collection of data in process of accumulation. The practical work of the office has three aims: (1) to collect and analyse family records for the purpose of studying heredity; (2) to organise courses for the training of the "field workers" to be employed in the collection of data; (3) to advise concerning the eugenical fitness of proposed marriages. For funds the office is principally indebted to Mrs. E. H. Harriman, but Mr. J. D. Rockefeller has also made generous contributions in providing for the salaries of five "field workers" and for the publication of memoirs and half the cost of the training class.

Major Greig gives an account of the present incidence of enteric or typhoid fever in India in a paper contributed to the All-India Sanitary Conference in Madras, 1912. The disease has greatly declined, as the following figures show:—Average admission per 1000 in 1895–1904, 22·3, in 1910, 4·1; constantly sick per 1000 in 1895–1904, 3·31, in 1910, 0·91; deaths per 1000 in 1895–1904, 5·62, in 1910, 0·62. The factors concerned in this decline are (*a*) segregation of the convalescent enteric patient until he is proved to be free from infection, (*b*) the elimination of the chronic carrier, (*c*) inoculation, (*d*) general sanitary improvement.

The curator's report of the Otago University Museum for 1912 records the definite transfer to the university of the Hocken library—consisting, it may be remembered, of a valuable collection of books, pamphlets, manuscripts, plans, and pictures relating to the history of New Zealand and the Maoris. Some idea of the size of the library may be gleaned from the statement that the printed catalogue of the bound books runs to several volumes.

A discovery of special importance in connection with the problem of the homology of the mammalian auditory ossicles is recorded by Mr. R. W. Palmer, University College, Reading. In dissecting the auditory region of a fœtal Australian bandicoot (Perameles) it was found that the ossicles and cartilages lie freely in a hollow of the thin dentary bone of the lower jaw, and comparison of their position, form, and relations with the corresponding region of the skull in certain Triassic anomodont reptiles renders it practically certain that the mammalian malleus represents the articular bone of the reptilian lower jaw, while the incus of the mammal corresponds to the quadrate of the reptile and the tympanic to the angular element of the jaw. The paper is published in the *Anatomischer Anzeiger*, vol. xliii., p. 512.

We have received from the publishers (Herren R. Friedländer und Sohn, Berlin) five parts, 34–38, of "Das Tierreich," edited by Dr. F. E. Schulze. These parts deal respectively with the butterflies of the family Amathusiidæ, the rhabdocelid turbellarian worms, the pteropod molluscs, the cæcilian amphibians, and the molluscs of the group Solenogastres; and the mere fact that the second of these (No. 35) comprises no fewer than 484 pages of text, coupled with the large number of parts already issued, gives some indication of the voluminous nature of the work. To how many parts it is expected to run we have no clue, but it may be mentioned that mammals and fishes are not touched in any of those already issued. Each part being separately paged, the entire work can be arranged in such order as may be best suited to the needs of individual students. So far as we can judge, the parts before us, which, like the rest, are by specialists in their respective subjects, maintain the high standard of their predecessors. As might have been expected in a work by different authors, the style of treatment is by no means uniform; the diagnoses of the species and groups being in some instances models of conciseness, while in others they tend to undue prolixity. The attention of "zoological recorders" may be directed to the fact that a new generic name is proposed on p. 17 of the part on Solenogastres, which may be an indication that others occur elsewhere in this invaluable work.

The report of the Meteorological Committee for the year ended March 31 differs from its predecessors in at least one important respect, viz. the omission of most of the usual appendices. These interesting documents are to be issued subsequently. The detailed reports of the work of the several divisions of the office, based to some extent upon such appendices, appear as heretofore. We are pleased to see that H.M. the King has shown his interest in the work by commanding that a copy of the useful daily weather report be regularly addressed to him. At the request of the Treasury, the committee is negotiating with the Scottish Meteorological Society with the object, *inter alia*, of securing closer cooperation with this body in respect of the supply of meteorological information to the public. It is stated that the committee has been much interested in a proposal for the more general use of the centimetre-gramme-second system of units in meteorological publications, and, for reasons given, they have decided to use the centibar or millibar instead of the inch, as far as possible, for all barometric measurements. Specimens of the daily and weekly weather reports are given with isobars shown for centibars (100=29·52 in.), and temperatures shown on the absolute temperature scale (273° A.=32° F.). Another important change refers to the modification of the code of signals hitherto used for storm warnings. All classes of weather forecasts issued during the year 1912 were very successful; many valuable wireless reports were received from H.M. ships, and a very large number from Atlantic liners, but only about one-twentieth of the latter reached the office in time to be included in "to-day's" map in the daily weather report, although nearly half of them could be utilised in one of the two smaller maps for "yesterday" shown in that report.

On October 3, Sir Joseph Thomson formally opened the new works of Messrs. W. G. Pye and Co. at Chesterton, near Cambridge, and in the course of his speech gave an account of his own connection with the establishment of Cambridge as an instrument-making centre. A laboratory in which any considerable amount of physical research is carried out requires an instrument maker of its own, and twenty-two years ago Sir Joseph appointed Mr. Pye to the post at the Cavendish laboratory. Under his management the laboratory workshops were greatly improved, and many exceedingly effective instruments turned out. In the meantime, a small business started by Mr. Pye developed and soon demanded his whole attention. This led to his resignation of the laboratory post eleven years ago. Since that time the business has grown so rapidly as to necessitate removal to a site admitting of further extensions in the future.

In the *Verhandlungen* of the German Physical Society for September 15, Drs. Gehlhoff and Neumeier, of the Danzig-Langfuhr Technical School, give the results of their measurements of the thermal and electrical properties of a series of alloys of bismuth and antimony at temperatures between −190° and 100° C. The principal results relate to the thermal and electrical conductivities which were determined by a modification of the method used by Lees. They show that the quotient of the thermal by the electrical conductivity and by the absolute temperature is not a constant as it should be according to the electronic theories of conduction, by decreases by 40 to 70 per cent. as the temperature rises from −190° to 100° C. The authors point out that this behaviour is analogous to that found by Lees for steel, nickel, and several alloys, and that it confirms the belief that the conduction of heat in many metallic conductors cannot be satisfactorily explained by the motion of free electrons.

Hitherto the laws of thermodynamics have been applied to gases, and also to investigations of the radiation pressure in a black body-cavity, but little has been done to combine gaseous pressure and radiation pressure in a single investigation. In the Bulletin of the Cracow Academy for May, Mr. T. Bialobjeski works out the conditions of equilibrium of a self-gravitating spherical mass of gas when radiation pressure is taken into account. The solution is essentially mathematical, namely, a deduction of conclusions from previously stated hypothesis; thus, to simplify matters, the author assumes the ordinary formulæ for a perfect gas and Stefan's formula for radiation pressure. The investigation has an important application to astrophysics, as it is shown that the equilibrium of the sun and stars may be affected by radiation pressure in a marked degree.

The revised London County Council reinforced concrete regulations governing the erection of reinforced concrete buildings in the London area have been amended by the Local Government Board, and have been submitted to the professional societies for further revision. These regulations have been the subject of much criticism, and additional comment on them is made by Mr. E. S. Andrews in *The Engineer* for October 3. Mr. Andrews points out that, to render the regulations reasonable and to remove some of the absurdities which arise in their application in some instances, further amendment is required, especially in questions of working stresses and modular ratios. The clauses governing these values penalise rich mixtures of concrete in the case of all rectangular beams, and also in many cases of beams of **T** section. The decrease in modular ratio suggested by the Local Government Board is reasonable, but the working stresses in the concrete do not increase for the richer mixtures in anything like the same ratio as obtains in actual experiment. Applied to columns, the regulations as to working stresses do not lead to obviously absurd results, but they do have the effect of discouraging the use of richer mixtures.

Messrs. George Routledge and Sons, Ltd., have in the press, and will shortly publish, "A Handbook of Photomicrography," by H. Lloyd Hind and W. Brough Randles. The new work will contain an account of the modern methods employed in photomicrography, with a description of the apparatus and processes, treated both from a microscopic and photographic point of view.

OUR ASTRONOMICAL COLUMN.

BRILLIANT METEOR OF OCTOBER 7.—A very fine meteor, which illuminated the heavens like a flash of lightning, was observed at various places in the west of England on October 7 at 10.35 p.m. It was seen by Mr. F. T. Naish at Bishopston, Bristol, and he recorded the position of the streak, which endured for nearly half a minute, as from $337^{\circ}+8^{\circ}$ to $327^{\circ}-2^{\circ}$. As observed by Miss Eleonora Armitage at Swainswick, near Bath, the meteor is described as coming rapidly from overhead and disappearing in Aquila. It left a luminous trail about 10° long, lasting for a few seconds.

Mr. F. C. Carey, of H.M.S. *Illustrious*, Devonport, noticed a lightning-like flash, and on looking upwards saw in due east, altitude 60°, a luminous train which was brighter in the upper portion and remained visible for several seconds.

The meteor was also visible from Keynsham, near Bristol, and by several other observers at Bristol.

From the data collected by Mr. Denning, he finds that the meteor had a probable radiant in Gemini, and that its height was from about seventy-four to fifty-two miles. The position of the flight was from over Wiltshire to the English Channel, about ten miles east of Paignton, Devonshire. Further observations are needed of a more exact character to determine its real path accurately. The meteor was a very swift one of the Leonid type, and it appeared on a very unsettled, showery evening, when, unfortunately, the sky was cloudy at many places.

COMETARY OBSERVATIONS IN 1909 TO 1912.—The principal contents of No. 12 of the *Mitteilungen der Hamburger Sternwarte* relate to the observations made of comets which appeared in the interval included in the years 1909 to 1912. The observations there recorded are both visual and photographic, the former being made with an equatorial of 256 mm. aperture and 3·02 m. focal length, and the latter with a 158 mm. Petzval objective of 760 mm. focal length, and a 5-in. Cooke triplet of 600 mm. focal length. Dr. K. Graff gives an account of the physical observations made with the large equatorial, and accompanies his remarks with an excellent series of drawings of the detailed structures in the heads of the various comets observed. Prof. A. Schwassmann limits his account to Brooks's comet (1911*c*), and describes in detail the chief points which are noticeable on the fine series of photographs which accompany the text. This publication also includes the observations made for the determinations of the positions of the comets and numerous minor planets, all made with the large equatorial by the observers, Dr. K. F. Bottlinger, Dr. K. Graff, and Herr H. Thiele.

NORMAL SYSTEM OF WAVE-LENGTHS IN THE SPECTRUM OF THE IRON ARC.—In this column for October 2 reference was made under the heading "The Wave-lengths of Certain Iron Lines" to the work of Dr. F. Goos. The current number of *The Astrophysical Journal* (vol. xxxviii., No. 2, p. 141) contains a further contribution by him towards "the establishment of a normal system of wave-lengths in the arc spectrum of iron." The main object of the communication is to show that it is not sufficient to prescribe a current of 5 to 10 amperes for the arc, as was adopted by the International Solar Union, but that it is absolutely necessary to define the manner of burning and the part of the arc used. Dr. Goos recommends the following procedure, based on many experiments:—

For the normal spectrum of iron he proposes an arc 5 mm. long (separation of the rounded ends from each other) between iron rods 6 mm. in diameter and with a current of 4 amperes. It should be used on a 220-volt circuit; the potential difference at the arc then falls to between 45 and 49 volts. It should be used with a pole changer, and the arc so projected on the slit of the spectrograph with the condensing lens that only a portion of the arc at the middle is used extending 1·5 mm. vertically at most. In order to show the importance of specifying exactly the arc conditions to be used, he directs attention to the difference in the values of the three observers of the normals of the second order. Thus he compares the wave-lengths of the iron arc as published by Kayser and himself with the measurements of St. John and Ware. He also includes measurements of the widths of some selected iron lines. The main cause of all the differences is due to pressure changes, and the whole investigation shows that the iron arc is far from homogeneous. Dr. Goos finally questions whether the measurements of the normals of the third order form a really homogeneous system, and he proposes that an entirely new series of observations should be made with more uniform light-sources.

MICROSCOPICAL EXAMINATION OF SKIN AND LEATHER.

IN the May number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, M. Georges Abt, of the Pasteur Institute, contributes an interesting and valuable paper on the microscopical examination of skin and leather, with special reference to salt stains and their effect.

The author first describes in detail the methods used for cutting and staining sections of skin. These are the general methods familiar to microscopists, but are varied slightly in order to differentiate the important histological elements of the skin for the particular purpose in view. The author endeavours to classify the different changes taking place in the skin during the various processes of manufacture into leather, and even goes so far as to suggest that the microscopical examination of the skin or hide in the various stages might be used to control the various processes.

In connection with his special investigation, the effect of salt stains, the author has prepared sections of the grain, flesh, and interior of the raw skin, the pelt, and of the finished leather, showing the characteristics of salt stains and their effect.

The work is supplementary, and supports the hypothesis deduced by the same writer from a chemical investigation of these stains ("Collegium," 1912, pp. 388–408). M. Abt differentiates between two types of salt stains. Stains of the first class are distinguished by the presence of calcium phosphate in places where grains of calcium sulphate have been deposited from the salt. In the section through these stains the nuclei of the connective tissue are very prominent. The author has proved them to contain iron and excess of tannin in the sections of stained leather. He assumes that these nuclei have been protected from the destructive action of micro-organisms in the preliminary processes by an envelope of an organic iron salt and of iron and calcium phosphate, and he goes on to show that as the salt stain progresses the nuclei ultimately disappear, the connective tissues being disintegrated, but not completely decomposed, as they would be by the action of bacteria, as claimed by Becker.

The second kind of stain investigated only applied to horse hides and to leather made therefrom. These are characterised by the presence of strongly pigmented epithelial tissues and the complete absence of calcium phosphate. The writer assum s, therefore, that these special stains proceed from the brown pigment in the cells of the Malpighi layer and internal epithelial hair sheath in the original skin. This pigment becomes fixed by mineral matter so that decomposition in the limes is resisted.

The author finds that the common factor in the stains examined is the presence of traces of iron. The persistence of the connective elements, especially the nuclei and epithelial tissues, is proved, and the very slight changes that take place in the connective tissue lead the writer to conclude that bacteria play a very small part in the production of the stains he examined.

In this paper M. Abt, for the stains he has examined, takes up practically the opposite view to that enunciated by Becker, who claims that many of the salt stains are largely caused by bacterial action.

The experiments carried out by M. Abt have been carefully performed, and the hypothesis he draws from the results obtained on the stains he has examined appear to be conclusive. The paper is extremely well illustrated by coloured photographs of prepared sections of normal and salt-stained skin and leather which are very clear, and are much more defined than the illustrations usually given in this type of work; in fact, these microphotographs are from magnificent sections, and are beautifully reproduced in the article. They are the finest reproductions of the structure of the hide and skin that have been published in recent times.

M. Abt's work on this subject is of great importance to leather technologists, and, while the author does not claim to have solved all the various kinds of salt stains, he has certainly solved a portion of the difficult problem, and appears to have definitely proved that what the tanner and leather-dresser call salt stains may originate from more than one cause, and may under different conditions vary in appearance and effect upon the skin.

The paper shows that M. Abt has carried out a very careful and systematic investigation, and it is a most valuable contribution to the elucidation of this problem, but in spite of this the subject is still by no means exhausted, and we venture to hope that M. Abt will investigate some other forms of salt stains which he has not yet dealt with. Although the author has undoubtedly clearly proved the cause, traced the history, and shown the effect of certain forms of salt stains, he has not yet described any practical method of avoiding this economic waste which is so vital to the tanners of calf and other similar leathers, but the paper brings us one step nearer this goal.

J. G. P.

THE BRITISH ASSOCIATION AT BIRMINGHAM.

SECTION H.

ANTHROPOLOGY.

Opening Address by Sir Richard C. Temple, Bart., C.I.E., President of the Section.

Administrative Value of Anthropology.

The title of the body of which those present at this meeting form a section is, as all my hearers will know, the British Association for the Advancement of Science, and it seems to me therefore that the primary duty of a sectional President is to do what in him lies, for the time being, to forward the work of his section. This may be done in more than one way: by a survey of the work done up to date and an appreciation of its existing position and future prospects, by an address directly forwarding it in some particular point or aspect, by considering its applicability to what is called the practical side of human life. The choice of method seems to me to depend on the circumstances of each meeting, and I am about to choose the last of those above mentioned, and to confine my address to a consideration of the administrative value of anthropology because the locality in which we are met together and the spirit of the present moment seem to indicate that I shall best serve the interests of the anthropological section of the British Association by a dissertation on the importance of this particular science to those who are or may hereafter be called upon to administer the public affairs of the lands in which they may reside.

I have to approach the practical aspect of the general subject of anthropology under the difficulty of finding myself once more riding an old hobby, and being consequently confronted with views and remarks already expressed in much detail. But I am not greatly disturbed by this fact, as experience teaches that the most effective way of impressing ideas, in which one believes, on one's fellow man is to miss no opportunity of putting them forward, even at the risk of repeating what may not yet have been forgotten. And as I am convinced that the teachings of anthropologists are of practical value to those engaged in guiding the administration of their own or another country, I am prepared to take that risk.

Anthropology is, of course, in its baldest sense the study of mankind in all its possible ramifications, a subject far too wide for any one science to cover, and therefore the real point for consideration on such an occasion as this is not so much what the students of mankind and its environments might study if they chose, but what the scope of their studies now actually is, and whither it is tending. I propose, therefore, to discuss the subject in this limited sense.

What, then, is the anthropology of to-day that claims to be of practical value to the administrator? In what directions has it developed?

Perhaps the best answer to these questions is to be procured from our own volume of "Notes and Queries on Anthropology," a volume published under the arrangements of the Royal Anthropological Institute for the British Association. This volume of "Notes and Queries" has been before the public for about forty years, and is now in the fourth edition, which shows a great advance on its predecessors and conforms to the stage of development to which the science has reached up to the present time.

The object of the "Notes and Queries" is stated to be "to promote accurate anthropological observation on the part of travellers including all local observers) and to enable those who are not anthropologists themselves to supply information which is wanted for the scientific study of anthropology at home." So, in the heads under which the subject is considered in this book, we have exhibited to us the entire scope of the science as it now exists. These heads are (1) physical anthropology, (2) technology, (3) sociology, (4) arts and sciences. It is usual, however, nowadays to divide the subject into two main divisions—physical and cultural anthropology.

Physical anthropology aims at obtaining "as exact a record as possible of the structure and functions of the human body, with a view to determining how far these are dependent on inherited and racial factors, and how far they vary with environment." This record is based on two separate classes of physical observation: firstly on descriptive characters, such as types of hair, colour of the eyes and skin, and so on, and actual measurement; and secondly on attitudes, movements, and customary actions. By the combined study of observations on these points physical heredity is ascertained, and a fair attribution of the race or races to which individuals or groups belong can be arrived at.

But anthropology, as now studied, goes very much further than inquiry into the physical structure of the human races. Man, "unlike other animals, habitually reinforces and enhances his natural qualities and force by artificial means." He does, or gets done for him, all sorts of things to his body to improve its capacities or appearance, or to protect it. He thus supplies himself with sanitary appliances and surroundings, with bodily ornamentation and ornaments, with protective clothing, with habitations and furniture, with protection against climate and enemies, with works for the supply of water and fire, with food and drink, drugs and medicine. And for these purposes he hunts, fishes, domesticates animals, and tills the soil, and provides himself with implements for all these, and also for defence and offence, and for the transport of goods, involving working in wood, earth, stones, bones, shells, metals and other hard materials, and in leather, strings, nets, basketry, matting and weaving, leading him to what are known as textile industries. Some of this work has brought him to mine and quarry, and to employ mechanical aids in the shape of machinery, however rude and simple. The transport of himself and his belongings by land and water has led him to a separate set of industries and habits: to the use of paths, roads, bridges, and halting places, of trailers, sledges, and wheeled vehicles; to the use of rafts, floats, canoes, coracles, boats, and ships, and the means of propelling them, poles, paddles, oars, sails, and rigging. The whole of these subjects is grouped by anthropologists under the term technology, which thus becomes a very wide subject, covering all the means by which a people supplies itself with the necessaries of its mode of livelihood.

In order to carry on successfully what may be termed the necessary industries or even to be in a position to cope with them, bodies of men have to act in concert, and this forces mankind to be gregarious, a condition of life that involves the creation of social relations. To understand, therefore, any group of mankind, it is essential to study sociology side by side with technology. The subjects for inquiry here are the observances at crucial points in the life-history of the individual—birth, puberty, marriage, death, daily life, nomenclature, and so on; the social organisation and the relationship of individuals. On these follow the economics of the social group, pastoral, agricultural, industrial, and commercial, together with conceptions as to property and inheritance (including slavery), as to government, law and order, politics and morals; and finally the ideas as to war and the external relations between communities.

We are still, however, very far from being able to understand in all their fulness of development even the crudest of human communities without a further inquiry into the products of their purely mental activities, which in the "Notes and Queries" are grouped under the term "Arts and Sciences." Under this head are to be examined, in the first place, the expression of the emotions to the eye by physical movements and conditions, and then by gestures, signs and signals, before we come to language, which is primarily expressed by the voice to the ear, and secondarily to the eye in a more elaborate form by the graphic arts—pictures, marks and writing. Man further tries to express his emotions by what are known as the fine arts; that is by modifying the material articles which he contrives for his livelihood in a manner that makes them represent to him something beyond their economic use—makes them pleasant, representative or symbolical—leading him on to draw, paint, enamel, engrave, carve and mould. In purely mental efforts this striving to satisfy the artistic or æsthetic sense takes the form of stories, proverbs, riddles, songs, and music. Dancing, drama, games, tricks and amusements are other manifestations of the same effort, combining in these cases the movements of the body with those of the mind in expressing the emotions.

The mental processes necessary for the expression of his emotions have induced man to extend his powers of mind in directions now included in the term "abstract reasoning." This has led him to express the results of his reasoning by such terms as reckoning and measurement, and to fix standards for comparison in such immaterial but all essential matters as enumeration, distance, surface, capacity, weight, time, value, and exchange. These last enable him to reach the idea of money, which is the measurement of value by means of tokens, and represents perhaps the highest economic development of the reasoning powers common to nearly all mankind.

The mental capacities of man have so far been considered only in relation to the expression of the emotions and of the results of abstract reasoning; but they have served him also to develop other results and expressions equally important, which have arisen out of observation of his surroundings, and have given birth to the natural sciences: astronomy, meteorology, geography, topography, and natural history. And further they have enabled him to memorise all these things by means of records, which in their highest form have brought about what is known to all of us as history, the bugbear of impulsive and shallow thinkers, but the very backbone of all solid opinion.

The last and most complex development of the mental processes, dependent upon all the others according to the degree to which they themselves have been developed in any given variety of mankind, is, and has always been, present in every race or group on record from the remotest to the most recent time in some form or other and in a high degree. Groups of men observe the phenomena exhibited by themselves or their environment, and account for them according to their mental capacity as modified by their heredity. Man's bare abstract reasoning, following on his observation of such phenomena, is his philosophy, but his inherited emotions influence his reasoning to an almost controlling extent and induce his religion, which is thus his philosophy or explanation of natural phenomena as effected by his hereditary emotions, producing that most wonderful of all human phenomena, his belief. In the conditions, belief, faith, and religion must and do vary with race, period, and environment.

Consequent on the belief, present or past of any given variety of mankind, there follow religious practices (customs as they are usually called) based thereon, and described commonly in terms that are familiar to all, but are nevertheless by no means even yet clearly defined: theology, heathenism, fetishism, animism, totemism, magic, superstition, with soul, ghost, and spirit, and so on, as regards mental concepts; worship, ritual, prayer, sanctity, sacrifice, taboo, &c., as regards custom and practice.

Thus have the anthropologists, as I understand them, shown that they desire to answer the question as to what their science is, and to explain the main points in the subject of which they strive to obtain and impart accurate knowledge based on scientific inquiry: that is, on an inquiry methodically conducted on lines which experience has shown them will lead to the minimum of error in observation and record.

I trust I have been clear in my explanation of the anthropologists' case, though in the time at my disposal I have been unable to do more than indicate the subjects they study, and have been obliged to exercise restraint and to employ condensation of statement to the utmost extent that even a long experience in exposition enables one to achieve. Briefly, the science of anthropology aims at such a presentation and explanation of the physical and mental facts about any given species or even group of mankind as may correctly instruct those to whom the acquisition of such knowledge may be of use. In this instance, as in the case of the other sciences, the man of science endeavours to acquire and pass on abstract knowledge, which the man of affairs can confidently apply in the daily business of practical life.

It will have been observed that an accurate presentation of the physical and mental characteristics of any species of mankind which it is desired to study is wholly dependent on accurate inquiry and report. Let no one suppose that such inquiry is a matter of instinct or intuition, or that it can be usefully conducted empirically or without due reference to the experiences of others; in other words, without sufficient preliminary study. So likely indeed are the uneducated in such matters to observe and record facts about human beings inaccurately, or even wrongly, that about a fourth part of the "Notes and Queries" is taken up with showing the inquirer how to proceed, and in exposing the pitfalls into which he may unconsciously fall. The mainspring of error in anthropological observation is that the inquirer is himself the product of heredity and environment. This induces him to read himself, his own unconscious prejudices and inherited outlook on life, into the statements made to him by those who view life from perhaps a totally different and incompatible standpoint. To the extent that the inquirer does this, to that extent are his observations and report likely to be inaccurate and misleading. To avoid error in this respect, previous training and study are essential, and so the "Notes and Queries on Anthropology," a guide compiled in cooperation by persons long familiar with the subject, is as strong and explicit on the point of how to inquire as on that of what to inquire about.

Let me explain that these statements are not intended to be taken as made *ex cathedrâ*, but rather as the outcome of actual experience of mistakes made in the past. Time does not permit me to go far into this point, and I must limit myself to the subject of sociology for my illustration. If a man undertakes to inquire into the social life of a people or tribe as a subject apart, he is committing an error, and his report will almost certainly be misleading. Such an investigator will find that religion and technology are inextricably mixed up with the sociology of any given tribe, that religion intervenes at every point not only of sociology but also of language and technology. In fact, just as in the case of all other scientific research, the phenomenon observable by the anthropologist are not the result of development along any single line alone, but of a progression in a main general direction, as influenced, and it may be even deflected, by contact and environment.

If again the inquirer neglects the simple but essential practice of taking notes, not only fully, but also immediately or as nearly so as practicable, he will find that his memory of facts, even after a short time, has become vague, inexact, and incomplete, which means that reports made from memory are more likely to be useless than to be of any scientific value. If voluntary information or indirect and accidental corrobation are ignored, if questions are asked and answers accepted without discretion, if exceptions are mistaken for rules, then the records of an inquiry may well mislead and thus become worse than useless. If leading or direct questions are put without due caution, and if the answers are recorded without reference to the natives' and not the inquirer's mode of classifying things, crucial errors may easily arise. Thus, in many parts of the world, the term "mother" includes all female relatives of the past or passing generation, and the term "brother" the entire brotherhood. Such expressions as "brother" and "sister" may and do constantly connote relationships which are not recognised at all amongst us. The word "marriage" may include "irrevocable betrothal," and so on; and it is very easy to fall into the trap of the mistranslation of terms of essential import, especially in the use of words expressing religious conceptions. The conception of godhead has for so long been our inheritance that it may be classed almost as instinctive. It is nevertheless still foreign to the instincts of a large portion of mankind.

If also, when working among the uncultured, the inquirer attempts to ascertain abstract ideas, except through concrete instances, he will not succeed in his purpose for want of representative terms. And lastly, if he fails to project himself sufficiently into the minds of the subjects of inquiry, or to respect their prejudices, or to regard seriously what they hold to be sacred, or to keep his countenance while practices are being described which to him may be disgusting or ridiculous—if indeed he fails in any way in communicating to his informants, who are often super-sensitively suspicious in such matters, the fact that his sympathy is not feigned—he will also fail in obtaining the anthropological knowledge he is seeking. In the words of the "Notes and Queries" on this point, "Nothing is easier than to do anthropological work of a certain sort, but to get to the bottom of native customs and modes of thought, and to record the results of inquiry in such a manner that they carry conviction, is work which can be only carried out properly by careful attention."

The foregoing considerations explain the scope of our studies and the requirements of the preliminary inquiries necessary to give those studies value. The further question is the use to which the results can be put. The point that at once arises here for the immediate purpose is that of the conditions under which the British Empire is administered. We are here met together to talk scientifically, that is, as precisely as we can: and so it is necessary to give a definition to the expression "Imperial Administration," especially as it is constantly used for the government of an empire, whereas in reality it is the government that directs the administration. In this address I use the term "administration" as the disinterested management of the details of public affairs. This excludes politics from our purview, defining that term as the conduct of the government of a country according to the opinions or in the interests of a particular group or party.

Now in this matter of administration the position of the inhabitants of the British Isles is unique. It falls to their lot to govern, directly or indirectly, the lives of members of nearly every variety of the human race. Themselves Europeans by descent and intimate connection, they have a large direct interest in every other general geographical division of the world and its inhabitants. It is worth while to pause here for a moment to think, and to try and realise, however dimly, something of the task before the people of this country in the government and control of what are known as the subject races.

For this purpose it is necessary to throw our glance over the physical extent of the British Empire. In the first place, there are the ten self-governing components of the Dominion of Canada and that of Newfoundland in North America, the six colonial States in the Commonwealth of Australia, with the Dominion of New Zealand in Australasia, and the four divisions of the Union of South Africa. All these may be looked upon as indirectly administered portions of the British Empire. Then there is the mediatised government of Egypt, with its appanage, the directly British administered Sudan, which alone covers about a million square miles of territory in thirteen provinces, in northern Africa. These two areas occupy, as it were, a position between the self-governing and the directly-governed areas. Of these, there are in Europe Malta and Gibraltar, Cyprus being officially included in Asia. In Asia itself is the mighty Indian Empire, which includes Aden and the Arabian coast on the west and Burma on the east, and many islands in the intervening seas, with its fifteen provinces and some twenty categories of native states "in subordinate alliance," that is, under general Imperial control. To these are added Ceylon, the Straits Settlements, and the Malay States, federated or other, North Borneo and Sarawak, and in the China Seas Hong Kong and Wei-hai-wei. In South Africa we find Basutoland, Bechuanaland, and Rhodesia; in British West Africa, Gambia, the Gold Coast, Sierra Leone, and Nigeria; in eastern and Central Africa, Somaliland, the East Africa Protectorate, Uganda, Zanzibar, and Nyassaland; while attached to Africa are the Mauritius, Seychelles, Ascension, and St. Helena. In Central and South America are Honduras and British Guiana, and attached to that continent the Falkland Islands, and also Bermuda and the six colonies of British West Indies. In the Pacific Ocean are Fiji, Papua, and many of the Pacific Islands.

I am afraid that once more during the course of this exposition I have been obliged to resort to a concentration of statement that is almost bewildering. But let that be. If one is to grapple successfully with a large and complex subject, it is necessary to try and keep before the mind, so far as possible, not only its magnitude, but the extent of its complexity. This is the reason for bringing before you, however briefly and generally, the main geographical details of the British Empire. The first point to realise on such a survey is that the mere extent of such an Empire makes the subject of its administration an immensely important one for the British people.

The next point for consideration and realisation is that an empire, situated in so many widely separated parts of the world, must contain within its boundaries groups of every variety of mankind, in such numerical strength as to render it necessary to control them as individual entities. They do not consist of small bodies lost in a general population, and therefore negligible from the administrator's point of view, but of whole races and tribes or of large detachments thereof.

These tribes of mankind profess every variety of religion known. They are Christians, Jews, Mahommedans, Hindus, Buddhists, Jains, Animists, and, to use a very modern expression, Animatists, adherents of main religions followed by an immense variety of sects, governed, however loosely, by every species of philosophy that is or has been in fashion among groups of mankind, and current in every stage of development, from the simplest and most primitive to the most historical and complex. One has to bear in mind that we have within our borders the Andamanese, the Papuan, and the Polynesian, as well as the highly civilised Hindu and Chinese, and that not one of these, nor indeed of many other peoples, has any tradition of philosophy or religion in common with our own; their very instincts of faith and belief following other lines than ours, the prejudices with which their minds are saturated being altogether alien to those with which we ourselves are deeply imbued.

The subjects of the British King-Emperor speak between them most of the languages of the world, and certainly every structural variety of human speech has its example somewhere in the British Empire. A number of these languages is still only in the process of becoming understood by our officials and other residents among their speakers, and let there be no mistake as to the magnitude of the question involved in the point of language alone in British Imperial regions. A man may be what is called a linguist. He may have a working knowledge of the main European languages and of the great Oriental tongues —Arabic, Persian, and Hindustani—which will carry him very far indeed among the people—in a sense, in fact, from London to Calcutta—and then, without leaving that compact portion of the British possessions known as the Indian Empire, with all its immense variety of often incompatible subordinate languages and dialects, he has only to step across the border into Burma and the Further East to find himself in a totally different atmosphere of speech, where not one of the sounds, not one of the forms, not one of the methods, with which he has become familiarised is of any service to him whatever. The same observation will again be forced on him if he transfers himself thence to southern Africa or to the Pacific Ocean. Let him wander amongst the North American Indians and he will find the linguistic climate once more altogether changed.

Greater Britain may be said to exhibit all the many varieties of internal social relations that have been set up by tribes and groups of mankind—all the different forms of family and general social organisation, of reckoning kinship, of inheritance and control of the possession of property, of dealing with the birth of children and their education and training, physical, mental, moral, and professional, in many cases by methods entirely foreign to British ideas and habits. For instance, infanticide as a custom has many different sources of origin.

Our fellow-subjects of the King follow, somewhere or other, all the different notions and habits that have been formed by mankind as to the relations between the sexes, both permanent and temporary, as to marriage and to what have been aptly termed supplementary unions. And finally, their methods of dealing with death and bringing it about, of disposing of the dead and worshipping them, give expression to ideas, which it requires study for an inhabitant of Great Britain to appreciate or understand. I may quote here, as an example, that of all the forms of human head-hunting and other ceremonial murder that have come within my cognisance, either as an administrator or investigator, not one has originated in callousness or cruelty of character. Indeed, from the point of view of the perpetrators, they are invariably resorted to for the temporal or spiritual benefit of themselves or their tribe. In making this remark, I must not be understood as proposing that they should not be put down, wherever that is practicable. I am merely trying now to give an anthropological explanation of human phenomena.

In very many parts of the British Empire, the routine of daily life and the notions that govern it often find no counterparts of any kind in those of the British Isles, in such matters as personal habits and etiquette on occasions of social intercourse. And yet, perhaps, nothing estranges the administrator from his people more than mistakes on these points. It is small matters—such as the mode of salutation, forms of address and politeness, as rules of precedence, hospitality, and decency, as recognition of superstitions, however apparently unreasonable—which largely govern social relations, which no stranger can afford to ignore, and which at the same time cannot be ascertained and observed correctly without due study.

The considerations so far urged to-day have carried us through the points of the nature and scope of the science of anthropology, the mental equipment necessary for the useful pursuit of it, the methods by which it can be successfully studied, the extent and nature of the British Empire, the kind of knowledge of the alien populations within its boundaries required by persons of British origin who would administer the Empire with benefit to the people dwelling in it, and the importance to such persons of acquiring that knowledge.

I now turn to the present situation as to this last point and its possible improvement, though in doing so I have to cover ground that some of those present may think I have already trodden bare. The main proposition here is simple enough. The Empire is governed from the British Isles, and therefore year by year a large number of young men are sent out to its various component parts, and to them must inevitably be entrusted in due course the administrative, commercial, and social control over many alien races. If their relations with the foreign peoples with whom they come in contact are to be successful, they must acquire a working knowledge of the habits, customs, and ideas that govern the conduct of those peoples, and of the conditions in which they pass their lives. All those who succeed find these things out for themselves, and discern that success in administration and commerce is intimately affected by success in social relations, and that that in its turn is dependent on the knowledge they may attain of those with whom they have to deal. They set about learning what they can, but of necessity empirically, trusting to keenness of observation, because such self-tuition is, as it were, a side issue in the immediate and imperative business of their lives. But, as I have already said elsewhere, the man who is obliged to obtain the requisite knowledge empirically, and without any previous training in observation, is heavily handicapped indeed in comparison with him who has already acquired the habit of right observation, and, what is of much more importance, has been put in the way of correctly interpreting his observations in his youth.

To put the proposition in its briefest form: in order to succeed in administration a man must use tact. Tact is the social expression of discernment and insight, qualities born of intuitive anthropological knowledge, and that is what it is necessary to induce in those sent abroad to become eventually the controllers of other kinds of men. What is required, therefore, is that in youth they should have imbibed the anthropological habit, so that as a result of having been taught how to study mankind, they may learn what it is necessary to know of those about them correctly, and in the shortest practicable time. The years of active life now unavoidably wasted in securing this knowledge, often inadequately and incorrectly even in the case of the ablest, can thus be saved, to the incalculable benefit of both the governors and the governed.

The situation has, for some years past, been appreciated by those who have occupied themselves with the science we are assembled here to promote, and several efforts have been made by the Royal Anthropological Institute and the Universities of Oxford, Cambridge, and London, at any rate to bring the public benefits accruing from the establishment of anthropological schools before the Government and the people of this country.

In 1902 the Royal Anthropological Institute sent a deputation to the Government with a view to the establishment of an official Anthropometric Survey of the United Kingdom, in order to test the foundation for fears, then widely expressed, as to the physical deterioration of the population. In 1909 the institute sent a second deputation to the present Government, to urge the need for the official training in anthropology of candidates for the Consular Service and of the Indian and Colonial Civil Services. There is happily every reason to hope that the Public Services Commission may act on the recommendations then made. This year (1913) the institute returned to the charge and approached the Secretary of State for India, with a view to making anthropology an integral feature of the studies of the Oriental Research Institute, to the establishment of which the Government of India had officially proposed to give special attention. The institute has also lately arranged to deal with all questions of scientific import that may come before the newly constituted Bureau of Ethnology at the Royal Colonial Institute, in the hope with its cooperation of eventually establishing a great *desideratum*—an Imperial Bureau of Ethnology. It has further had in hand a scheme for the systematic and thorough distribution of local correspondents throughout the world.

At Oxford, anthropology as a serious study was recognised by the appointment, in 1884, of a reader, who was afterwards given the status of a professor. In 1885, it was admitted as a special subject in the final honours school of natural science. In 1904, a memorandum was drawn up by those interested in the study at the University, advocating a method of systematic training in it, which resulted in the formation of the committee of anthropology in the following year. This committee has established a series of lectures and examinations for a diploma, which can be taken as part of the degree course, but is open to all officers of the public services as well. By these means a school of anthropology has been created at Oxford, which has already registered many students, among whom officers engaged in the administration of the British Colonies in Africa and members of the Indian Civil Service have been included. The whole question has been systematically taken up in all its aspects, the instruction, formal and informal, comprising physical anthropology, psychology, geographical distribution, prehistoric archæology, technology, sociology, and philology.

At Cambridge, in 1893, there was a recognised lecturer in physical anthropology, an informal office now represented by a lecturer in physical anthropology and a reader in ethnology, regularly appointed by the University. In 1904, as a result of an expedition to Torres Straits, a board of anthropological studies was formed, and a diploma in anthropology instituted, to be granted, not for success in examinations, but in recognition of meritorious personal research. At the same time, in order to help students, among whom were included officials of the African and Indian Civil Services, the Board established lectures on the same subjects as those taught at Oxford. This year, 1913, the University has instituted an anthropological tripos for its degrees on lines similar to the others. The distinguishing feature of the Cambridge system is the prominence given to field work, and this is attracting foreign students of all sorts.

In 1909, joint representations were made by a deputation from the Universities of Oxford and Cambridge to both the India and Colonial Offices, advocating the training of Civil Service candidates and probationers in ethnology and primitive religion.

In 1904, the generosity of a private individual established a lectureship in ethnology in connection with the University of London, which has since developed into a professorship of ethnology with a lectureship in physical anthropology. In the same year the same benefactor instituted a chair of sociology. In 1909 the University established a board of anthropology, and the subject is now included in the curricula for the degrees of the University. In and after 1914, anthropology will be a branch of the science honours degree. The degree course of the future covers both physical and cultural anthropology in regard to zoology, palæontology, physiology, psychology, archæology, technology, sociology, linguistics, and ethnology. There will also be courses in ethnology with special attention to field work for officials and missionaries, and it is interesting to note that students of Egyptology are already taking a course of lectures in ethnology and physical anthropology.

Though the universities have thus been definite enough in their action where the authority is vested in them, it is needless to say that their representations to Governments have met with varying success, and so far they have not produced much practical result. But it is as well to note here that a precedent for the preliminary anthropological training of probationers in the Colonial Civil Service has been already set up, as the Government of the Sudan has directed that every candidate for its services shall go through a course of anthropology at Oxford or Cambridge. In addition to this, the Sudan Government has given a grant to enable a competent anthropologist from London to run a small scientific survey of the peoples under its administration. The Assam Government has arranged its ethnographical monographs on the lines of the British Association's "Notes and Queries" with much benefit to itself, and it is believed that the Burma Government will do likewise. The Colonial Office has appointed a lecturer in anthropology for East and West Africa, and the Government of India is distributing copies of the anthropological articles in its Imperial Gazetteer to successful candidates for its civil services.

Speaking in this place to such an audience as that before me, and encouraged by what has already been done elsewhere, I cannot think that I can be mistaken in venturing to recommend the encouragement of the study of anthropology to the University of such a city as Birmingham, which has almost unlimited interests throughout the British Empire. For it should be remembered that anthropological knowledge is as useful to merchants *in partibus* in dealing with aliens as to administrators so situated. Should this suggestion bear fruit, and should it be thought advisable some day to establish a school of anthropology in Birmingham, I would also venture to point out that there are two requirements preliminary to the successful formation of almost any school of study. These are a library and a museum *ad hoc*. At Oxford there is a well-known and well-conducted anthropological museum in the Pitt-Rivers collection, and the museum of archæology and ethnology at Cambridge contains collections of the greatest service to the anthropologist. Liverpool is also interesting itself in such matters. The Royal Anthropological Institute is forming a special library, and both that institute and the University of London have the benefit of the splendid collections of the British Museum and of the Horniman Museum readily accessible. The libraries at Oxford and Cambridge are, I need scarcely say, of world-wide fame. At all these places of learning, then, these requisites for this department of knowledge are forthcoming.

It were almost superfluous to state why they are requisites. Every student requires, not only competent teachers to guide him in his particular branch of study, but also a library and a museum close at hand, where he can find the information he wants and the illustration of it. Where these exist, thither it will be found that students will flock. Birmingham possesses peculiar facilities for the formation of both, as the city has all over the Empire its commercial representatives, who can collect the required museum specimens on the spot. The financial labours also of those who distribute these men over Greater Britain, and indeed all over the world, produce the means to create the library and the school, and their universal interests provide the incentive for securing for those in their employ the best method of acquiring a knowledge of men that can be turned to useful commercial purpose. Beyond these suggestions I will not pursue this point now, except to express a hope that this discourse may lead to a discussion thereon before this meeting breaks up.

Before I quit my subject I would like to be somewhat insistent on the fact that, though I have been dwelling so far exclusively on the business side, as it were, of the study of anthropology, it has a personal side as well. I would like to impress once more on the student, as I have often had occasion to do already, that whether he is studying of his own free will or at the behest of circumstances, there is scarcely any better hobby in existence than this, or one that can be ridden with greater pleasure. It cannot, of course, be mastered in a day. At first the lessons will be a grind. Then, until they are well learnt, they are irksome, but when fullness of knowledge and maturity of judgment are attained, there is, perhaps, no keener sense of satisfaction which human beings can experience than that which is afforded by this study. Its range is so wide, its phases so very many, the interests involved in it so various, that it cannot fail to pleasantly occupy the leisure hours from youth to full manhood, and to be a solace, in some aspect or other, in advanced life and old age.

The processes of discovery in the course of this study are of such interest in themselves that I should wish to give many instances, but I must confine myself now to one or two. The student will find on investigation, for instance, that however childish the reasoning of savages may appear to be on abstract subjects, and however silly some of their customs may seem, they are neither childish nor silly in reality. They are almost always the result of "correct argument from a false premiss"—a mental process not unknown to civilised races. The student will also surely find that savages are not fools where their concrete interests are concerned, as they conceive those interests to be. For example, in commerce, beads do not appeal to savages merely because they are pretty things, except for purposes of adornment. They will only part with articles they value for particular sorts of beads which are to them money, in that they can procure in exchange for them, in their own country, something they much desire. They have no other reason for accepting any kind of bead in payment for goods. On few anthropological points can mistakes be made more readily than on this, and when they are made by merchants, financial disaster can well follow, so that what I have already said elsewhere as to this may bear repetition in part here. Savages in their bargains with civilised man never make one that does not, for reasons of their own, satisfy themselves. Each side, in such a case, views the bargain according to its own interest. On his side, the trader buys something of great value to him, when he has taken it elsewhere, with something of little value to him, which he has brought from elsewhere, and then, and only then, can he make what is to him a magnificent bargain. On the other hand, the savage is more than satisfied, because with what he has got from the trader he can procure from among his own people something he very much covets, which the article he parted with could not have procured for him. Both sides profit by the bargain from their respective points of view, and traders cannot, as a matter of fact, take undue advantage of savages, who, as a body, part with products of little or no value to themselves for others of vital importance, though these last may be of little or none to the civilised trader. The more one dives into recorded bargains, the more clearly one sees the truth of this view.

I have always advocated personal inquiry into the native currency and money, even of pre-British days, of the people amongst whom a Britisher's lot is cast, for the reason that the study of the mental processes that lead up to commercial relations, internal and external, the customs concerned with daily buying and selling, take one more deeply into aliens' habits of mind and their outlook on practical life than any other branch of research. The student will find himself involuntarily acquiring a knowledge of the whole life of a people, even of superstitions and local politics, matters that commercial men, as well as administrators, cannot, if they only knew it, ever afford to ignore. The study has also a great intellectual interest, and neither the man of commerce nor the man of affairs should disregard this side of it if he would attain success in every sense of that term.

Just let me give one instance from personal experience. A few years back a number of ingots of tin, in the form of birds and animals and imitations thereof, hollow tokens of tin ingots, together with a number of rough notes taken on the spot, were handed over to me for investigation and report. They came from the Federated Malay States, and were variously said to have been used as toys and as money in some form. A long and careful investigation unearthed the whole story. They turned out to be surviving specimens of an obsolete and forgotten Malay currency. Bit by bit, by researches into travellers' stories and old records, European and vernacular, it was ascertained that some of the specimens were currency and some money, and that they belonged to two separate series. Their relations to each other were ascertained, and also to the currencies of the European and Oriental nations with whom the Malays of the Peninsula had come in contact. The mint profit in some instances, and in other instances the actual profit European Governments and mercantile authorities, and even native traders, had made in recorded transactions of the past, was found out. The origin of the British, Dutch, and Portuguese money, evolved for trading with the Malays, was disclosed, and several interesting historical discoveries were made; as, for instance, the explanation of the coins still remaining in museums and issued in 1510 by the great Portuguese conqueror, Albuquerque, for the then new Malay possessions of his country, and the meaning of the numismatic plates of the great French traveller Tavernier in the next century. Perhaps the most interesting, and anthropologically the most important, discovery was the relation of the ideas that led up to the animal currency of the Malays to similar ideas in India, Central Asia, China, and Europe itself throughout all historical times. One wonders how many people in these isles grasp the fact that our own monetary scale of 960 farthings to the sovereign, and the native Malay scale of 1,280 cash to the dollar, are representatives of one and the same universal scale, with more than probably one and the same origin out of a simple method of counting seeds, peas, beans, shells, or other small natural constant weights. But the point for the present purpose is that not only will the student find that long practice in anthropological inquiry, and the learning resulting therefrom, will enable him to make similar discoveries, but also that the process of discovery is intensely interesting. Such discoveries, too, are of practical value. In this instance they have taught us much of native habits of thought and views of life in newly acquired possessions which no administrator there, mercantile or governmental, can set aside with safety.

I must not dwell too long on this aspect of my subject, and will only add the following remark. If any of my hearers will go to the Pitt-Rivers Museum at Oxford he will find many small collections recording the historical evolution of various common objects. Among them is a series showing the history of the tobacco pipe, commonly known to literary students in this country as the nargileh and to Orientalists as the hukka. At one end of the series will be found a hollow coconut with an artificial hole in it, and then every step in evolution between that and an elaborate hukka with its long, flexible, drawing-tube at the other end. I give this instance as I contributed the series, and I well remember the eagerness of the hunt in the Indian bazaars and the satisfaction on proving every step in the evolution.

There is one aspect of life where the anthropological instinct would be more than useful, but to which, alas, it cannot be extended in practice. Politics, government, and administration are so interdependent throughout the world that it has always seemed to me to be a pity that the value to himself of following the principles of anthropology cannot be impressed on the average politician of any nationality. I fear it is hopeless to expect it. Were it only possible the extent of the consequent benefit to mankind is at present beyond human forecast, as then the politician could approach his work without that arrogance of ignorance of his fellow-countrymen on all points except their credulity that is the bane of the ordinary types of his kind wherever found, with which they have always poisoned and are still poisoning their minds, mistaking the satisfaction of the immediate temporary interests and prejudices of themselves and comrades for the permanent advantage of the whole people, whom, in consequence, they incontinently misgovern whenever and for so long as their country is so undiscerning as to place them in power.

Permit me, in conclusion, to enforce the main argument of this address by a personal note. It was my fortune to have been partly trained in youth at a university college, where the tendency was to produce men of affairs rather than men of the schools, and only the other day it was my privilege to hear the present master of the college, my own contemporary and fellow-undergraduate, expound the system of training still carried out there. "In the government of young men," he said, "intellect is all very well, but sympathy counts for very much more." Here we have the root principle of applied anthropology. Here we have in a nutshell the full import of its teaching. The sound administration of the affairs of men can only be based on cultured sympathy, that sympathy on sure knowledge, that knowledge on competent study, that study on accurate inquiry, that inquiry on right method, and that method on continuous experience.

SECTION I.

PHYSIOLOGY.

Opening Address by F. Gowland Hopkins, F.R.S., President of the Section.

The Dynamic Side of Biochemistry.

In the year 1837 Justus Liebig, whom we may rightly name the father of modern animal chemistry, presented a report to the Chemical Section of the British Association, then assembled at Liverpool. The technical side of this report dealt with the products of the decomposition of uric acid, with which I am not at the moment concerned, but it concluded with remarks which, to judge from other contemporary writings of Liebig, would have been more emphatic had the nature of his brief communication permitted. Liebig had a profound belief that in the then new science of organic chemistry, biology was to find its greatest aid to progress, and his enthusiastic mind was fretted by the cooler attitude of others. In the report I have mentioned he called upon the chemists of this country to take note of what was in the wind, and while complimenting British physiologists and biologists upon their own work, urged upon them the immediate need of combining with the chemists. Ten years later, Liebig had still to write with reference to chemical studies: "Der Mann welcher in der Thierphysiologie wie Saussure in der Pflanzenphysiologie die ersten und wichtigsten Fragen zur Aufgabe seines Lebens macht, fehlt noch in dieser Wissenschaft" (Ann. Chem. Pharm., lxii., 257, 1847). Much later still, he was still making the same complaint. As a matter of fact, the combination of chemistry with biology, in the full and abundant sense that Liebig's earlier enthusiasm had pictured as so desirable, never happened in any country within the limits of his own century, while in this country, up to the end of that century, it can scarcely be said to have happened at all. But the regrettable divorce between these two aspects of science has been so often dwelt upon that you will feel no wish to hear it treated historically, and perhaps even any emphasis given to it now may seem out of place, since on the Continent, and notably in America, the subject of biochemistry (with its new and not very attractive name) has come with great suddenness into its kingdom. Even in this country the recent successful formation of a Biochemical Society gives sure evidence of a greatly increased interest in this borderland of science. Yet I am going to ask you to listen to some remarks which are a reiteration of Liebig's appeal, as heard by this association three-quarters of a century ago.

For one can, I think, honestly say that it is yet a rare thing in this country to meet a professed biologist, even among those unburdened either with years or traditions, who has taken the trouble so to equip himself in organic chemistry as to understand fully an important fact of metabolism stated in terms of structural formulæ. The newer science of physical chemistry has made a more direct appeal to the biological mind. Its results are expressed in more general terms and the bearing of its applications are perhaps more obvious, especially at the present moment. This fact increases the danger of a further neglect in biology of the organic structural side of chemistry, upon which, nevertheless, the whole modern science of intermediary metabolism depends. On the other hand, I think one may say that there are only a few among the present leaders of chemical thought in our midst who have set themselves to appraise with sympathy the drift of biological processes or the nature of the problems that biologists have before them. Anyone wishing to see the number of biochemical workers increased might therefore with equal justice appeal to the teachers of biology or to the teachers of chemistry for greater sympathy with the borderland. It is a moot point indeed as to which is the better side for that borderland to recruit its workers from.

But on the whole it is easier for the intelligent adult mind to grasp new problems than to learn a new technique. It is better that youth should be spent in acquiring the latter. That is why, though I admit that it would have been more obviously to the point if made some ten years ago, I feel justified in repeating to-day the appeal of Liebig to the leading chemists of this country, in the hope that they may see their way to direct the steps of more of their able students into the path of biochemistry. I have been specially tempted to do this, rather than to speak upon some of many subjects which would have interested this section more, for a very practical reason. I have been in a position to review the current demand of various institutions, home and Colonial, for the services of trained biochemists, and can say, I think with authority, that the demand will rapidly prove to be in excess of the supply. It will be a pity if the generation of trained chemists now growing up in this country should not share in the restoration of this balance. You certainly have the right to tell me that I ought, in the circumstances, to be addressing another section; but it may be long before any member of my cloth will have the opportunity of appealing to that section from the position of advantage that I occupy here. I believe you will forgive the particular trajectory of my remarks, because I am sure you will sympathise with their aim. Moreover, I have some hope that the considerations upon which I shall chiefly base my appeal will have some interest for members of this section as well as for the chemist. My main thesis will be that in the study of the intermediate processes of metabolism we have to deal, not with complex substances which elude ordinary chemical methods, but with simple substances undergoing comprehensible reactions. By simple substances I mean such as are of easily ascertainable structure and of a molecular weight within a range to which the organic chemist is well accustomed. I intend also to emphasise the fact that it is not alone with the separation and identification of products from the animal that our present studies deal; but with their reactions in the body; with the dynamic side of biochemical phenomena.

I have made it my business during the last year or two to learn, by means of indirect and most diplomatic inquiries, the views held by a number of our leading organic chemists with respect to the claims of animal chemistry. I do not find any more the rather pitying patronage for an inferior discipline, and certainly not that actual antagonism, which fretted my own youth; but I do find still very widely spread a distrust of the present methods of the biochemist, a belief that much of the work done by him is amateurish and inexact. What is much more important, and what one should be much more concerned to deny (though but a very small modicum of truth is, or ever was, in the above indictment), is the view that such faults are due to something inherent in the subject.

My desire is to point out that continuous progress, yielding facts which, by whomsoever appraised, belong to exact science, has gone on in the domain of animal chemistry from the days of Liebig until now, and that if this progress was until recently slow, it was, in the main, due to a continuance of the circumstance which so troubled Liebig himself—the shortage of workers.

But we must also remember that the small band of investigators who concerned themselves with the chemistry of the animal in the latter half of the nineteenth century suffered very obviously from the fact that the channels in which chemistry as a whole was fated to progress left high and dry certain regions of the utmost importance to their subject. In three regions particularly the needs of biochemistry were insistent. The colloid state of matter dominates the milieu in which vital processes progress, but, notwithstanding the stimulating work of Graham, the pure chemist of the last century consistently left colloids on one side with a shudder of distaste. Again, we have come to recognise that the insidious influence of catalysts is responsible for all chemical change as it occurs in living matter, but for many years after Berzelius the organic chemist gave to the subject of catalysis very cursory attention, fundamental though it be. Lastly, every physiological chemist has to realise that among his basal needs is that of accurate methods for the estimation of organic substances when they are present in complex mixtures. But the organic chemist of the nineteenth century did not develop the art of analysis on these lines. Of the myriad substances, natural or artificial, known to him at the most a few score could be separated quantitatively from mixtures, or estimated with any accuracy. It was a professional or commercial call rather than scientific need which evolved such processes as were available, so that this side of chemical activity developed only on limited and special lines.

All these circumstances were, of course, inevitable. Organic chemistry in Liebig's later years was concerned with laying its own foundations as a pure science, and for the rest of the century with building a giant, self-contained edifice upon them. The great business of developing the concepts of molecular structure and the wonderful art of synthesis were so absorbing as to leave neither leisure nor inclination for extraneous labours. But it is easy to recognise that, near the beginning of the present century, a sense of satiety had arisen in connection with synthetic studies carried out for their own sake. Workers came to feel that, so far as the fundamental theoretical aspects of chemistry were concerned, that particular side of organic work had played its part. In numerous centres, instead of only in a few, quite other aspects of the science were taken up: in particular, the study of the dynamic side of its phenomena. The historian will come to recognise that a considerable revolution in the chemical mind coincided roughly with the beginning of this century. Among the branches which are fated to benefit by this revolution—it is to be hoped in this country as well as others—is the chemistry of the animal.

But I would like to say that I do not find, on reading the contributions to science of those who, as professed physiological chemists, ploughed lonely furrows in the last century, any justification for the belief that the work done by them was amateurish or inexact; no suggestion that anything inherent in the subject is prone to lead to faults of the kind. Truly these workers had to share ignorance which was universal, and sometimes, compelled by the urgency of certain problems, had perforce to do their best in regions that were dark. But they knew their limitations here as well as their critics did, and relied for their justification upon the application of their results, which was often not understood at all by their critics.

There is little doubt, for instance, that it was the earlier attempts of various workers to fractionate complex colloid mixtures that led to the cynical statement that "*Thierchemie* is *Schmierchemie*." But the work thus done, even such work as Kühne's upon the albumoses and peptones, had important bearings, and led indirectly to the acquirement of facts of great importance to physiology and pathology.

In connection with enzyme catalysis the work done at this time by physiological chemists was in the main of a pioneer character, but it was urgently called for and had most useful applications. By the end of the century, indeed, it had become of great importance. I recall an incident which illustrates the need of suspended judgment before work done in new regions is assumed to be inexact. In 1885 E. Schütz published a study of the hydrolysis of protein by pepsin which showed that the rate of action of the ferment is proportionate to the square root of its concentration. When this paper was dealt with in Maly's "Jahresbericht" the abstractor (who from internal evidence, I believe, was Richard Maly himself) believed so little in such an apparent departure from the laws of mass action that he saw fit to deal with the paper in a ribald spirit, and to add, as a footnote to his abstract, the lines:—

> "Musst mir meine Erde
> Doch lassen steh'n
> Und meine Hütte die du nicht gebaut!"

Yet it is now known that the relation brought to light by Schütz does hold for certain relative concentrations of ferment and substrate. That it had limitations was shown by Schütz himself. The fact, however, involves no such shaking of the foundations as the abstractor thought. We quite understand now how such relations may obtain in enzyme-substrate systems.

As for analytical work involving a separation of complex organic mixtures, the biochemist of the last century was in this ahead of the pure organic chemist, as the development of urinary analysis if considered alone will show.

In countless directions the acquirement of exact knowledge concerning animal chemistry has been, as I have already claimed, continuous from Liebig's days until now. I would like in a brief way to illustrate this, and if I choose for the purpose one aspect of things rather than another, it is because it will help me in a later discussion. I propose to remind you of certain of the steps by which we acquired knowledge concerning the synthetic powers of the animal body, apologising for the great familiarity of many of the facts which I shall put before you.

It seems that the well-known Glasgow chemist and physician, Andrew Ure, was the first actually to prove, from observations made upon a patient, that an increased excretion of hippuric acid follows upon the administration of benzoic acid. Wöhler had earlier fed a dog upon the latter substance, and decided at the time that it was excreted unchanged; but when, later, Liebig had made clear the distinction between the two acids, Wöhler recalled the properties of the substance excreted by his dog, and decided that it must have been hippuric acid and not benzoic acid itself. Excited by the novel idea that a substance thus extraneously introduced might be caught up in the machinery of metabolism, Wöhler, immediately after the publication of Dr. Ure's statement, initiated fresh experiments in his laboratory at Göttingen, where Keller, by observations made upon himself, showed unequivocally that benzoic acid is, and can be on a large scale, converted into hippuric acid in the body. Thus was established a fact which is now among the most familiar, but which at that time stirred the imagination of chemists and physiologists not a little. The discovery immediately led to a large number of observations dealing with various conditions which affect the synthesis, but we may pass to the acute observations of Bertagnini. This investigator wished to earmark, as it were, the benzoic acid administered to the animal, in order to make sure that it was the same molecule which reappeared in combination. He so marked it with a nitro-group, giving nitro-benzoic acid and observing the excretion of nitro-hippuric acid. Later on he continued this interesting line of research by giving other substituted benzoic acids, and showed that in each case a corresponding substituted hippuric acid was formed. Even so far back as the earlier 'fifties a clear understanding was thus established that the body was possessed of a special mechanism capable of bringing a particular class of substances into contact with the amino-acid glycine, and of converting them, by means of a synthetical condensation (which had not then been induced by any laboratory method), into conjugates which, as later experiments have shown, are invariably less noxious for the tissues than the substances introduced. Great is the number of compounds which are now known to suffer this fate. To the story begun by Ure and Wöhler, chapter after chapter has been added continuously up to the present day. In 1876 came the classical experiments of Bunge and Schmiedeberg. After laborious but successful efforts to obtain a good method for the estimation of hippuric acid in animal fluids, these authors proved, by a method of exclusion, that, in the dog at least, the kidney is the seat of the hippuric synthesis. When, in their carefully controlled experiments, blood containing benzoic acid and glycine was circulated through that organ, after its isolation from the body, the production of hippuric acid followed. Schmiedeberg, a little later, convinced himself that the reaction in the kidney was a balanced one; the organ can not only synthesise hippuric acid, it can also hydrolise it. As with reactions elsewhere, so in the kidney cell, the equilibrium of the reaction depends on the relative concentration of the products concerned. Schmiedeberg then separated from the tissues of the kidney what he believed to be an enzyme capable of inducing the hydrolysis. Mutch, with improved methods, has recently shown that a preparation from the kidney, wholly free from intact cells, can, beyond all doubt, hydrolise hippuric acid under rigidly aseptic conditions, the reaction being one which comes to an equilibrium point when some 97 per cent. of the substance is broken down. The occurrence of this equilibrium, and the form of the reaction-velocity curve as obtained by Mutch, suggested that synthesis under the influence of the enzyme was to be expected, and, on submitting the mixture of benzoic acid and glycine to its influence, Mutch obtained a product which, though too small in amount for analysis, was almost certainly hippuric acid. I have myself obtained evidence which shows that the synthesis does certainly occur under these conditions.

The significance of this earliest known synthesis in the body is no limited one. The amide linkage established by it is one with which the body deals widely, and is, of course, of the type which is dominant in tissue complexes, since it is one which unites the amino-acids in the protein molecule.

Seeing, from the nature of the material supplied for the synthesis by the body itself, that the foreign substances administered must intrude themselves into the machinery of protein metabolism, it is not surprising that many have turned their minds to consider how far a detailed study of the phenomena might throw light upon this machinery. How far can the body extend its supply of glycine when stimulated by increasing doses of benzoic acid? What effects follow when administration is pushed to its limits? How is the fate in metabolism of the whole molecule of protein affected when one particular amino-acid is inharmoniously removed? Can the amino-acid be itself synthesised *de novo* in response to the call for it? These and similar questions clearly arise. I can only stop to remind you that there is evidence that, in connection with this particular chemical synthesis, the carnivore reacts differently to the herbivore. If the body of the former be flooded with benzoic acid, only a proportion undergoes condensation. Only so much glycine is supplied as would correspond, roughly, at any rate, with that rendered available by the normal contemporary breakdown of protein, whereas, in the herbivorous animal, pushing the administration of benzoic acid may lead to the excretion of so much conjugated glycine that it may contain more than half of the whole nitrogen excreted. This is, of course, much more than could come from the protein of the body, and it would seem that the amino-acid is prepared *de novo* for an express purpose, a significant thing. But I must not stop to consider questions which are still in course of study. Before the hippuric synthesis was first observed synthetic powers were thought to be absent from the animal. Since then we have been continuously learning of fresh instances of synthesis in the body, not only in connection with its treatment of foreign substances, with which I am just now concerned, but in connection with all its normal processes.

Another most interesting group of syntheses in which substances are so dealt with in the body as to reappear in conjugation with protein derivatives are those in which the sulphur group plays its part. In 1876 Baumann first introduced us to the ethereal sulphates of the urine, and, from much subsequent work, we know how great a group of substances, chiefly those of phenolic character, are, after administration, excreted linked to sulphuric acid. We have evidence to show that, in all probability, the original condensation is not with sulphuric acid itself, but that oxidation of a previously formed sulphur containing conjugate has preceded excretion, and we know that another group of substances leave the body combined with unoxidised sulphur. Certain cyanides—the aliphatic nitriles, for example—reappear as sulphocyanides; but, above all in interest, is the case described by Baumann, in which the intact cystein complex of protein, after suffering acetylation of its amino group, is excreted as a conjugate. The administration of halogen-benzene compounds is followed by the appearance of the so-called mercapturic acids in which the cystein is linked by its sulphur atom to the ring of chlor-, bromo-, or iodi-benzene. That large amounts of these conjugates can be formed during the twenty-four hours is certain, but it would be interesting to know what limit is set to this loss of cystin from the body.

I will now recall to you syntheses in which the substance supplied by the body is derived, not from protein, but from carbohydrate. The study of the fate of camphor in the body, carried out by Schmiedeberg and Hans Meyer in 1878, if it stood by itself, would abundantly illustrate the significance of this type of experiment. As you are aware, these workers proved that, after the administration of camphor, the urine contains a conjugate formed between an oxidation product of the camphor and an oxidation product of glucose. Both substances were then new to chemistry, and the latter—glycuronic acid—has since proved itself of great physiological interest. After Schmiedeberg's and Hans Meyer's experiments it was realised for the first time that the sugar molecule might play a part in metabolism quite distinct from its function as fuel, a fact that has much of cogency at the present time. We have good reason to believe that though, as a matter of fact, glycuronic acid is a normal metabolite, the actual synthesis concerns sugar itself, the oxidation of the glucose molecule occurring later. The compound formed is of the glucoside type, and the analogy with the formation of glucosides in the plant is unmistakable. Already the number of substances known to suffer this particular synthesis is legion. Almost every organic group yields an example.

Lastly, in illustration of a quite different type of synthesis (I can only deal with a few of the many known cases) we may recall the methylation which certain compounds undergo. The mechanism of this process, as it occurs in the body, is obscure, and its explanation would be of the greatest chemical interest. I must mention only one particular instance investigated by Ackermann. When nicotinic acid is fed to animals, it is excreted as trigonellin, a known vegetable base. This conversion involves methylation, and is of striking character as an instance of the artificially induced production of a plant alkaloid in the animal body.

The full significance of all such happenings will not be understood unless it be remembered that a nice adjustment of molecular structure is in many cases necessary to prepare the foreign substance for synthesis. Preliminary regulated oxidations or reductions may occur so as to secure, for example, the production of an alcoholic or phenolic hydroxyl group, which then gives the opportunity for condensation which was otherwise absent.

I have touched only on the fringes of this domain. The body of knowledge available concerning it has not been won systematically, and the fate of a multitude of other types of organic substances remains for investigation. The known facts have, one feels, an academic character in the view of the physiologist, and even in that of the pharmacologist, to whom we owe most of our knowledge about them. But, in my opinion, the chemical response of the tissues to the chemical stimulus of foreign substances of simple constitution is of profound biological significance. Apart from its biological bearings as the simplest type of immunity reaction, it throws vivid light, and its further study must throw fresh light on the potentialities of the tissue laboratories.

In a brilliant address delivered before the faculty of medicine of the University of Leeds, Lord Moulton likened the process of recovery in the tissues after bacterial invasion to the generation of forces which establish what is known to the naval architect as the "righting couple." This grows greater the greater the displacement of a ship, and finally may become sufficient to overpower the forces tending to make her heel over. It is surely striking to realise that the establishment of the "righting couple" which brings the tissue cell back to equilibrium after the disturbances due to the intrusion of simple molecules calls for such a complex of chemical events, events which ultimately result in the modification of the disturbing substance and its extrusion from the tissues concerned in a form less noxious to the body as a whole.

Oxidation, reduction, desaturation, alkylation, acylation, condensation; any or all of these processes may be brought *de novo* into play as the result of the intrusion of a new molecule into reactions which were in dynamic equilibrium. It is clear that chemical systems capable of so responding to what may be termed specific chemical stimuli must not be neglected by any student of chemical dynamics. The physiologist has for many years been engaged upon careful analyses of the mechanical and electric responses to stimulation. In the phenomena before us we find "responses" which are equally fundamental. If we do not study them exhaustively we shall miss an important opportunity for throwing light upon the nature of animal tissues as chemical systems.

One reason which has led the organic chemist to avert his mind from the problems of biochemistry is the obsession that the really significant happenings in the animal body are concerned in the main with substances of such high molecular weight and consequent vagueness of molecular structure as to make their reactions impossible of study by his available and accurate methods. There remains, I find, pretty widely spread, the feeling—due to earlier biological teaching—that, apart from substances which are obviously excreta, all the simpler products which can be found in cells or tissues are as a class mere dejecta, already too remote from the fundamental biochemical events to have much significance. So far from this being the case, recent progress points in the clearest way to the fact that the molecules with which a most important and significant part of the chemical dynamics of living tissues is concerned, are of a comparatively simple character. The synthetic reactions which we have already considered surely prepare us for this view; but it may be felt that, however important, they represent abnormal events, while the study of them has been largely confined to determining the end-products of change. Let me now turn to normal metabolic processes and to intermediary reactions.

We know first of all that the raw material of metabolism is so prepared as to secure that it shall be in the form of substances of small molecular weight; that the chief significance of digestion, indeed, lies in the fact that it protects the body from complexes foreign to itself. Abderhalden has ably summarised the evidence for this and has shown us also that, so far as the known constituents of our dietaries are concerned, the body is able to maintain itself when these are supplied to it wholly broken down into simple *bausteine,* any one of which could be artificially synthesised with the aid of our present knowledge. Dealing especially with the proteins, we have good reason to believe that the individual constituent amino-acids, and not elaborate complexes of these, leave the digestive tract, while Folin, Van Slyke, and Abel have recently supplied us with suggestive evidence for the fact that the individual amino-acids reach the tissues as such and there undergo change.

But still more important, when things are viewed from my present point of view, is the fact that recent work gives clear promise that we shall ultimately be able to follow, on definite chemical lines, the fate in metabolism of each amino-acid individually; to trace each phase in the series of reactions which are concerned in the gradual breakdown and oxidation of its molecule. Apart from the success to which it has already attained, the mere fact that the effort to do this has been made is significant. To those at least who are familiar with the average physiological thought of thirty years ago, it will appear significant enough. So long as there were any remains of the instinctive belief that the carbonic acid and urea which leave the body originate from oxidations occurring wholly in the vague complex of protoplasm, or at least that any intermediate products between the complex and the final excreta could only be looked for in the few substances that accumulate in considerable amount in the tissues (for instance, the creatin of muscle), the idea of seriously trying to trace within the body a series of processes which *begin* with such simple substances as tryosin or leucin was as foreign to thought as was any conception that such processes could be of fundamental importance in metabolism. However vaguely held, such beliefs lasted long after there was justification for them; their belated survival was due, it seems to me, to a certain laziness exhibited by physiological thought when it trenched on matters chemical; they disappeared only when those accustomed to think in terms of molecular structure turned their attention to the subject. But it should be clearly understood that the progress made in these matters could only have come through the work and thought of those who combined with chemical knowledge trained instinct and feeling for biological possibilities. Our present knowledge of the fate of amino-acids, as of that of other substances in the body, has only been arrived at by the combination of many ingenious methods of study.

It is easy in the animal, as in the laboratory, to determine the end-products of change; but, when the end result is reached in stages, it is by no means easy to determine what are the stages, since the intermediate products may elude us. And yet the whole significance of the processes concerned is to be sought in the succession of these stages. In animal experiments directed to the end under consideration, investigators have relied first of all upon the fact that the body, though the seat of a myriad reactions, and capable perhaps of learning, to a limited extent and under stress of circumstances, new chemical accomplishments, is in general able to deal only with what is customary to it. This circumstance has yielded two methods of determining the nature of intermediate products in metabolism. Considerations of molecular structure will, for instance, suggest several possible lines along which a given physiological substance may be expected to undergo change. We may test these possibilities by administering various derivatives of the substance in question. Only those which prove on experiment to be fully metabolised, or to yield derivatives in the body identical with those yielded by the parent substance, can be the normal intermediate products of its metabolism. All others may be rejected as not physiological. In a second method dependent upon this eclecticism of the body, substances are administered which so far differ from the normal that, instead of suffering a complete breakdown, they yield some residual derivative which can be identified in the excreta, and the nature of which will throw light upon the chemical mechanism which has produced it. For instance, a substance with a resistant (because abnormal) ring structure, but possessing a normal side chain, may be used to demonstrate how the side chain breaks down. Again, we may sometimes obtain useful information by administering a normal substance in excessive amounts, when certain intermediate products may appear in the excreta. Another most profitable method of experiment is that in which the substance to be studied is submitted to the influence of isolated organs instead of to that of the whole animal. Under these conditions, a series of normal reactions may go on, but with altered relative velocities, so that intermediate products accumulate; or again when, as may happen, the successive changes wrought upon a substance by metabolism occur in different organs of the body, this use of isolated organs enables us to dissect, as it were, the chain of events. Extraordinarily profitable have been the observations made upon individuals suffering from those errors of metabolism which Dr. Garrod calls "metabolic sports, the chemical analogues of structural malformations." In these individuals, nature has taken the first essential step in an experiment by omitting from their chemical structure a special catalyst which at one point in the procession of metabolic chemical events is essential to its continuance. At this point there is arrest, and intermediate products come to light.

As you know, most ingenious use of this ready-made experimental material has added greatly to our knowledge of intermediate metabolism. Admirable use, too, has been made of the somewhat similar conditions presented by diabetes, clinical and experimental. Every day our knowledge of the dynamics of the body grows upon these lines.

I know that the history of all these efforts is familiar to you, but I am concerned to advertise the fact that our problems call for ingenuity of a special sort, and to point out that an equipment in chemical technique alone would not have sufficed for the successful attack which has been made upon them. But I am even more concerned to point out that the direct method of attack has been too much neglected, or has been in the hands of too few; I mean the endeavour to separate from the tissues further examples of the simpler products of metabolic change, no matter how small the amount in which they may be present; an endeavour which ought not to stop at the separation and identification of such substances, but to continue until it has related each one of them to the dynamic series of reactions in which each one is surely playing a part. The earliest attempts at tracing the intermediate processes of metabolism looked for information to the products which accumulate in the tissues, but it seemed to be always tacitly assumed that only those few which are quantitatively prominent could be of importance to the main issues of metabolism. It is obvious, however, upon consideration, that the degree to which a substance accumulates is by itself no measure of its metabolic importance; no proof as to whether it is on some main line of change, or a stage in a quantitatively unimportant chemical by-path. For, if one substance be changing into another through a series of intermediate products, then, as soon as dynamical equilibrium has been established in the series, and to such equilibrium tissue processes always tend, the rate of production of any one intermediate product must be equal to the rate at which it changes into the next, and so throughout the series. Else individual intermediate products would accumulate or disappear, and the equilibrium be upset. Now the rate of chemical change in a substance is the product of its efficient concentration and the velocity constant of the particular reaction it is undergoing. Thus the relative concentration of each intermediate substance sharing in the dynamic equilibrium, or, in other words, the amount in which we shall find it at any moment in the tissue, will be inversely proportional to the velocity of the reaction which alters it. But the successive velocity constants in a series of reactions may vary greatly, and the relative accumulation of the different intermediate products must vary in the same degree. It is certain that in the tissues very few of such products accumulate in any save very small amount, but the amount of a product found is only really of significance if we are concerned with any function[1] which it may possibly possess. It is of no significance as a measure of the quantitative importance of the dynamical events which give rise to it.

To take an instance. The substance creatin has always asserted itself in our conceptions concerning nitrogenous metabolism because of the large amount in which it is found in the muscle. It may be of importance *per se*, and abnormalities in its fate are certainly important as an indication of abnormalities in metabolism, but we must remember that the work of Gulewitsch, Krimberg, Kutscher, and others has shown us that a great number of nitrogenous basic bodies exist in muscle in minute amounts. Maybe we shall need to know about each of these all that we now know, or are laboriously trying to know, about creatin, before the dynamics of basic nitrogen in muscle become clear. Fortunately for the experimenter, most of the raw materials required for tissue analysis are easily obtainable; there is no reason save that of the labour involved why we should not work upon a ton of muscle or a ton of gland tissue.

I am certain that the search for tissue products of simple constitution has important rewards awaiting it in the future, so long as physiologists are alive to the dynamical significance of all of them. Such work is laborious and calls for special instincts in the choice of analytical method, but, as I mentioned in an earlier part of this address, I am sure that high qualifications as an analyst should be part of the equipment of a biological chemist.

I should like now to say a few words concerning the actual results of this modern work upon intermediate metabolism, and will return to the amino-acids. It is clear that what I can say must be very brief.

We know that the first change suffered by an α-amino-acid when it enters the metabolic laboratories is the loss of its amino group, and, thanks to the labours of Knoop, Neubauer, Embden, Dakin, and others, we have substantial information concerning the mechanism of this change. The process involved

[1] A product of metabolism can only be said to have a "function" in a cell or in the body when, being the end-product of one reaction, it initiates or modifies reactions in another milieu.

in the removal of the amino group is not a simple reduction, which would yield a fatty acid, or substituted fatty acid, nor a hydrolytic removal which would leave an α-hydroxy-acid; but the much less to be expected process of an oxidative removal, which results in the production of a keto-acid.[2] If the direct evidence for this chemically most interesting primary change were to be held insufficient (though there is no insufficiency about it), its physiological reality is strongly supported by the proof given us by Knoop and Embden that the liver can resynthesise the original amino-acid from ammonia and the corresponding keto-acid. This profoundly significant observation is part of the evidence which is continually accumulating to show that all normal chemical processes of the body can suffer reversal. The next step in the breakdown involves the oxidation of the keto-acid, with the production of a fatty acid containing one carbon less than the original amino-acid. This in turn is oxidised to its final products along the lines of the β-oxidation of Knoop, two carbon atoms being removed at each stage of the breakdown. All this is true of the aliphatic α-amino-acids, and, with limitations, of the side chains of their aromatic congeners. In the case of certain amino-acids the course of breakdown passes through the stage of aceto-acetic acid. This happens to those of which the molecule contains the benzene ring, and Dakin has enabled us to picture clearly the path of change which involves the opening of the ring. This particular stage does not seem to occur in the breakdown of the aliphatic amino-acids, save in the case of leucin; the rule and the exception here being alike easy of explanation by considerations of molecular structure.

But direct breakdown on the lines mentioned is far from being the only fate of individual amino-acids in the body. The work of Lusk, completed by that of Dakin, has shown us that of seventeen amino-acids derived from protein no less than nine may individually yield glucose in the diabetic organism, and there are excellent grounds for believing (indeed, there is no doubt) that they do the same to a duly regulated extent in the normal organism. The remaining seven have been shown not to yield sugar, and there is therefore a most interesting contrast in the fate of two groups of the protein *Bausteine*. Those which yield sugar do not yield aceto-acetic-acid, and those which yield the latter are not glycogenic. One set, after undergoing significant preliminary changes, seems to join the carbohydrate path of metabolism, the other set ultimately joins a penultimate stage in the path which is traversed by fats.

I will here venture to leave for one moment the firm ground of facts experimentally ascertained. Unexplored experimentally, but quite certain so far as their existence is concerned, are yet other metabolic paths of prime importance, along which individual amino-acids must travel and suffer change. We know now from the results of prolonged feeding experiments upon young growing animals, which I myself, as well as many others, have carried out, that all the nitrogenous tissue complexes, as well as the tissue proteins, can be duly constructed when the diet contains no other source of nitrogen beside the amino-acids of protein. The purin and pyrimidin bases, for instance, present in the nuclear material of cells certainly take origin from particular amino-acids, though we have no right to assume that groups derived from carbohydrates or fats play no part in the necessary syntheses. While recent years have given us a wonderfully clear picture as to how the nucleic acids and the purin bases contained in them break down during metabolism, we have as yet no knowledge of stages in their synthesis. But it is clear that to discover these is a task fully open to modern experimental methods, and though a difficult problem, it is one ready to hand. Again, in specialised organs substances are made which are of great importance, not to the structure, but to the dynamics of the body. These have become familiar to us under the name of Hormones. We know the constitution of one of these only, adrenaline. The molecule of this exemplar has a simple structure of a kind which makes it almost certain to be derived from one of the aromatic amino-acids. It is clearly open to us to discover on what lines it takes origin. Facts of this kind, we may be sure, will form a special chapter of biochemistry in the future. I would like to make a point here quite important to my main contention that metabolism deals with simple molecules. As a pure assumption it is often taught, explicitly or implicitly, that although the bowel prepares free amino-acids for metabolism, only those which are individually in excess of the contemporary needs of the body for protein are directly diverted to specialised paths of metabolism, and these to the paths of destructive change. All others—all those which are to play a part in the intimacies of metabolism—are supposed to be first reconstructed into protein, and must therefore again be liberated from a complex before entering upon their special paths of change. But there is much more reason (and some experimental grounds) for the belief that the special paths (of which only one leads to the repair or formation of tissue protein) may be entered upon straightway. Mrs. Stanley Gardiner (then Miss Willcock) carried out some feeding experiments a few years ago, and in discussing these I pointed out that they offered evidence of the direct employment for special purposes of individual amino-acids derived as such from the bowel. It seemed at the time that the argument was misunderstood or felt to carry little weight, but later Prof. Kossel (*Johns Hopkins Hospital Bulletin*, March, 1912) quoted my remarks with approval and expressed agreement with the view that the *Bausteine* of the food protein must, in certain cases, be used individually and directly.

I wish I had time to illustrate my theme by some of the abundant facts available from quite other departments of metabolism; but I must pass on.

The chief thing to realise is that as a result of modern research the conception of metabolism in block is, as Garrod puts it, giving place to that of metabolism in compartments. It is from the behaviour of simple molecules we are learning our most significant lessons.

Now interest in the chemical events such as those we have been dealing with may still be damped by the feeling that, after all, when we go to the centre of things, to the bioplasm, where these processes are initiated and controlled, we shall find a milieu so complex that the happenings there, although they comprise the most significant links in the chain of events, must be wholly obscure when seen from the point of view of structural organic chemistry. I would like you to consider how far this is necessarily the case.

The highly complex substances which form the most obvious part of the material of the living cell are relatively stable. Their special characters, and in particular the colloidal condition in which they exist, determine, of course, many of the most fundamental characteristics of the cell: its definite yet mobile structure, its mechanical qualities, including the contractility of the protoplasm, and those other colloidal characters which the modern physical chemist is

[2] Dakin's recent work is giving us an insight into the mechanism of the keto-acid formation. Amino-acids in aqueous solution dissociate into ammonia and the corresponding keto-aldehyde. The oxidation involved is therefore concerned with the conversion of the aldehyde into the acid.

studying so closely. For the dynamic chemical events which happen within the cell, these colloid complexes yield a special milieu, providing, as it were, special apparatus, and an organised laboratory. But in the cell itself, I believe, simple molecules undergo reactions of the kind we have been considering. These reactions, being catalysed by colloidal enzymes, do not occur in a strictly homogeneous medium, but they occur, I would argue, in the aqueous fluids of the cell under just such conditions of solution as obtain when they progress under the influence of enzymes *in vitro*.

There is, I know, a view which, if old, is in one modification or another still current in many quarters. This conceives of the unit of living matter as a definite, if very large and very labile molecule, and conceives of a mass of living matter as consisting of a congregation of such molecules in that definite sense in which a mass of, say, sugar is a congregation of molecules, all like to one another. In my opinion, such a view is as inhibitory to productive thought as it is lacking in basis. It matters little whether in this connection we speak of a "molecule" or, in order to avoid the fairly obvious misuse of a word, we use the term "biogen," or any similar expression with the same connotation. Especially, I believe, is such a view unfortunate when, as sometimes, it is made to carry the corollary that simple molecules, such as those provided by foodstuffs, only suffer change after they have become in a vague sense a part of such a giant molecule or biogen. Such assumptions became unnecessary as soon as we learnt that a stable substance may exhibit instability after it enters the living cell, not because it loses its chemical identity, and the chemical properties inherent in its own molecular structure, by being built into an unstable complex, but because in the cell it meets with agents (the intracellular enzymes) which catalyse certain reactions of which its molecule is normally capable.

Exactly what sort of material might, in the course of cosmic evolution, have first come to exhibit the elementary characters of living stuff, a question raised in the presidential address which so stirred us last year, we do not, of course, know. But it is clear that the living cell as we now know it is not a mass of matter composed of a congregation of like molecules, but a highly differentiated system; the cell, in the modern phraseology of physical chemistry, is a system of coexisting phases of different constitutions.[3] Corresponding to the difference in their constitution, different chemical events may go on contemporaneously in the different phases, though every change in any phase affects the chemical and physico-chemical equilibrium of the whole system. Among these phases are to be reckoned not only the differentiated parts of the bioplasm strictly defined (if we can define it strictly) the macro- and micro-nuclei, nerve fibres, muscle fibres, &c., but the material which supports the cell structure, and what have been termed the "metaplasmic" constituents of the cell. These last comprise not only the fat droplets, glycogen, starch grains, aleurone grains, and the like, but other deposits not to be demonstrated histologically. They must be held, too—a point which has not been sufficiently insisted upon—to comprise the diverse substances of smaller molecular weight and greater solubility, which are present in the more fluid phases of the system—namely, in the cell juices. It is important to remember that change in any one of these constituent phases, including the metaplasmic phases, must affect the equilibrium of the whole cell system, and because of this necessary equilibrium-relation it is difficult to say that any one of the constituent phases, such as we find *permanently* present in a living cell, even a metaplasmic phase, is less essential than any other to the "life" of the cell, at least when we view it from the point of view of metabolism. It is extremely difficult and probably impossible by any treatment of the animal completely to deprive the liver of its glycogen deposits, so long as the liver cells remain alive. Even an extreme variation in the quantity is in the present connection without significance because, as we know, the equilibrium of a polyphasic system is independent of the mass of any one of the phases; but I am inclined to the bold statement that the integrity of metabolic life of a liver cell is as much dependent on the coexistence of metaplasmic glycogen, however small in amount, as upon the coexistence of the nuclear material itself; so in other cells, if not upon glycogen, at least upon other metaplasmic constituents.

Now we should refuse to speak of the membrane of a cell, or of its glycogen store, as living material. We should not apply the term to the substances dissolved in the cell juice, and, indeed, would scarcely apply it to the highly differentiated parts of the bioplasm if we thought of each detail separately. We are probably no more justified in applying it, when we consider it by itself, to what, as the result of microscopic studies, we recognise as "undifferentiated" bioplasm. On ultimate analysis we can scarcely speak at all of living matter in the cell; at any rate, we cannot, without gross misuse of terms, speak of the cell life as being associated with any one particular type of molecule. Its life is the expression of a particular dynamic equilibrium which obtains in a polyphasic system. Certain of the phases may be separated, mechanically or otherwise, as when we squeeze out the cell juices, and find that chemical processes still go on in them; but "life," as we instinctively define it, is a property of the cell as a whole, because it depends upon the organisation of processes, upon the equilibrium displayed by the totality of the coexisting phases

I return to my main point. The view I wish to impress upon you is that some of the most important phenomena in the cell, those involving simple reactions of the type which we have been discussing, occur in ordinary crystalloid solution. We are entitled to distinguish fluid (or more fluid) phases in the cell. I always think it helpful in this connection to think of the least differentiated of animal cells—to consider, for instance, the amœba. In this creature a fluid phase comes definitely into view with the appearance of the food vacuole. In this vacuole digestion goes on, and there can be no doubt, from the suggestive experimental evidence available, that a digestive enzyme, and possibly two successive enzymes (a pepsin followed by a trypsin) appear in it. It is now generally admitted that digestion in the amœba, though intracellular, is metaplasmic. The digestion products appear first of all in simple aqueous solution. Is it not unjustifiable to assume that the next step is a total "assimilation" of the products, a direct building up of all that is produced in the vacuole into the complexes of the cell? If there be any basis for our views concerning the specificity of, say, the tissue proteins, they must apply to the amœba no less than to the higher animal, and we must picture the building-up of its specific complexes as a selective process. The mixture of amino-acids derived from the proteins of the bacteria or other food eaten by it may be inharmonious with their balance in the amœba. Some have to be more directly dealt with, by oxidation or otherwise. If the digestive hydrolysis occur outside the complexes, we may most justifiably assume that other prepara-

[3] See in this connection the very able exposition of the views developed by Zwaardemaker and others, by Botazzi in Winterstein's "Handbuch," vol. i.

tive processes also occur outside them. We need not think of a visible vacuole as the only seat of such changes. Similar fluid phases in the cell may elude the microscope, and the phenomena would be just as significant if reactions occur in the water imbibed by the colloids of the cell or present in the intra-micellar spaces of the bioplasm. It is always important to remember that 75 per cent. of the cell substance consists of water.

All of these considerations we may apply to the tissue cells of the higher animal. To my mind, at least, the following considerations appeal. It is noteworthy that all the known complexes of the cell—the proteins, the phosphorous complexes, the nucleic acids, &c.—are susceptible to hydrolysis by catalytic agents, which are always present, or potentially present. If the available experimental evidence be honestly appraised, it points to the conclusion that only to hydrolytic processes are the complexes unstable. Under the conditions of the body they are, while intact, resistant to other types of change, their hydrolytic products being much more susceptible. Since hydroclastic agents are present in the cell we must suppose that there is, at any moment, equilibrium between the complexes and their water-soluble hydrolytic products, though the amount of the latter present at any moment may be very small. Now, I think we are entitled to look upon assimilation and dissimilation, while very strictly defined, as being dependent upon changes in this equilibrium alone. They are processes of condensation and hydrolysis respectively. Substances which are foreign to the normal constitution of the complexes—and these comprise not only strictly extraneous substances, but material for assimilation not yet ready for direct condensation, or metabolites which are no longer simple hydrolytic products—do not enter or re-enter the complexes. They suffer change within the cell, but not as part of the complexes. When, for instance, a supply of amino-acids transferred from the gut reaches the tissue cell, they may be in excess of the contemporary limits of assimilation; or, once more, individual acids may not be present in the harmonious proportion required to form the specific proteins in the cell. Are we to suppose that all nevertheless become an integral part of the complexes before the harmony is by some mysterious means adjusted? I think rather that the normality of the cell proteins is maintained by processes which precede actual condensation or assimilation. Conversely, when the cell balance sets towards dissimilation, the amino-acids liberated by hydrolysis suffer further changes outside the complexes. So when a foreign substance, say benzoic acid, enters the cell, we have no evidence, experimental or other, to suggest that such a body ever becomes an integral part of the complexes. Rather does it suffer its conjugation with glycine in the fluids of the cell. So also with cases of specific chemical manufacture in organs. When, for instance, adrenaline—a simple, definite crystalline body—appears in the cells of the gland which prepares it, are we to suppose that its molecule emerges in some way ready-made from the protein complexes of the gland, rather than that a precursor derived from a normal hydrolytic product of these proteins or from the food supply is converted into adrenaline by reactions of a comprehensible kind, occurring in aqueous solution, and involving simple molecules throughout? While referring to adrenaline, I may comment upon the fact that the extraordinarily wide influence now attributed to that substance is a striking illustration of the importance of simple molecules in the dynamics of the body.

It should be, of course, understood, though the consideration does not affect the essential significance of the views I am advancing, that the isolation of reactions in particular phases of the cell is only relative. I have before emphasised the point that the equilibrium of the whole system must, to a greater or less degree, be affected by a change in any one phase. A happening of any kind in the fluid phases must affect the chemical equilibrium and, no less, the physico-chemical equilibrium, between them and the complexes or less fluid phases. A drug may have an "action" on a cell, even though it remain in solution, and it may have a specific action because its molecular constitution leads it to intrude into, and modify the course of, some one, rather than any other, of the numerous simple chemical reactions proceeding in the cells of different tissues.

But I must now turn from consideration of the reactions themselves to that of their direction and control. It is clear that a special feature of the living cell is the organisation of chemical events within it. So long as we are content to conceive of all happenings as occurring within a biogen or living molecule all directive power can be attributed in some vague sense to its quite special properties.

But the last fifteen years have seen grow up a doctrine of a quite different sort which, while it has difficulties of its own, has the supreme merit of possessing an experimental basis and of encouraging by its very nature further experimental work. I mean the conception that each chemical reaction within the cell is directed and controlled by a specific catalyst. I have already more than once implicitly assumed the existence of intracellular enzymes. I must now consider them more fully.

Considering the preparation made for it by the early teaching of individual biologists, prominent among whom was Moritz Traube, it is remarkable that belief in the endo-enzyme as a universal agent of the cell was so slow to establish itself, though in the absence of abundant experimental proof scepticism was doubtless justified. So long as the ferments demonstrated as being normally attached to the cell were only those with hydroclastic properties, such as were already familiar in the case of secreted digestive ferments, the imagination was not stirred. Only with Buchner's discovery of zymase and cell-free alcoholic fermentation did the faith begin to grow. Yet, a quarter of a century before, Hoppe-Seyler had written (when discussing the then vexed question of nomenclature, as between organised and unorganised "ferments"): "The only question to be determined is whether that hypothesis is too bold which assumes that in the organism of yeasts there is a *substance* [the italics are mine] that decomposes sugar into alcohol and CO_2 . . . I hold the hypothesis to be *necessary* because fermentations are chemical events and must have chemical causes. . . ." If in the last sentence of this quotation we substitute for the word "fermentations" the words "the molecular reactions which occur within the cell," Hoppe-Seyler would, I think, have been equally justified.

Remembering, however, the great multiplicity of the reactions which occur in the animal body, and remembering the narrow specificity in the range of action of an individual enzyme, we may be tempted to pause on contemplating the myriad nature of the army of enzymes that seems called for. But before judging upon the matter the mind should be prepared by a full perusal of the experimental evidence. We must call to mind the phenomena of autolysis and all the details into which they have been followed; the specificity of the proteolytic ferments concerned, and especially the evidence obtained by Abderhalden and others, that tissues contain numerous enzymes, of which some act upon only one type of polypeptide, and some specifically on other polypeptides. We must remember the intracellular enzymes that slit the phosphorous complexes of the cell; the lipases, the amylases, and the highly specific invert ferments, each adjusted to the hydrolysis of a particular sugar. We have also to think of a large group of enzymes acting specifically upon other substances of simple constitution, such as the arginase of Kossel and Dakin, the enzyme recently described by Dakin which acts with great potency in converting pyruvic aldehyde into lactic acid, and many others. Nothing could produce a firmer belief in the reality and importance of the specialised enzymes of the tissues than a personal repetition of the experiments of Walter Jones, Schittenhelm, Wiechowski, and others, upon the agents involved in the breakdown of nucleic acids; each step in the elaborate process involves a separate catalyst. In this region of metabolism alone a small army of independent enzymes is known to play a part, each individual being of proven specificity. The final stages of the process involve oxidations which stop short at the stage of uric acid in man, but proceed to that of allantoin in most animals. It is very instructive to observe the clean, complete oxidation of uric acid to allantoin, which can be induced *in vitro* under the influence of Wiechowski's preparations of the uric acid oxidase, especially if one recalls at the same time, in proof of its physiological significance, that this oxidase, though always present in the tissues of animals, which excrete allantoin, is absent from those of man, who does not.

I will not trouble you with further examples. We have arrived, indeed, at a stage when, with a huge array of examples before us, it is logical to conclude that all metabolic tissue reactions are catalysed by enzymes, and, knowing the general properties of these, we have every right to conclude that all reactions may be so catalysed in the synthetic as well as in the opposite sense. If we are astonished at the vast array of specific catalysts which must be present in the tissues, there are other facts which increase the complexity of things. Evidence continues to accumulate from the biological side to show that, as a matter of fact, the living cell can acquire *de novo* as the result of special stimulation new catalytic agents previously foreign to its organisation.

It is certain, from very numerous studies made upon the lower organisms, and especially upon bacteria, that the cell may acquire new chemical powers when made to depend upon an unaccustomed nutritive medium. I must be content to quote a single instance out of many. Twort has shown that certain bacteria of the Coli-typhosus group can be trained to split sugars and alcohols which originally they could not split at all. A strain of *B. typhosus* which after being grown upon a medium containing dulcite had acquired the power of splitting this substance, retained it permanently, even after passage through the body of the guinea-pig, and cultivation upon a dulcite-free medium. Similar observations have been made upon the Continent by Massini and Burri; the latter showed by ingenious experiments that all the individuals of a race which acquires such a new property have the same potency for acquiring it. No one, at the present time, will deny that the appearance of a new enzyme is involved in this adjustment of the cell to a new nutritive medium.

We have not, it is true, so much evidence for similar phenomena in the case of the higher animals. The milk-sugar splitting ferment may be absent from the gut epithelium before birth, and in some animals may disappear again after the period of suckling, but here we probably have to do with some simple alternation of latency and activisation. But among the "protective" ferments studied by Abderholden we have, perhaps, cases in which specific individuals appear *de novo* as the result of injecting foreign proteins, &c., into the circulation. Consider, moreover, the case of the reactions called out by simpler substances. We have seen that an enzyme separable from the kidney tissue can catalyse the synthesis no less than the breakdown of hippuric acid. Now the cells of the mammalian kidney have always had to deal with benzoic acid or chemical precursors of benzoic acid, and the presence of a specific enzyme related to it is not surprising. But living cells are not likely to have ever been in contact with, say, bromo-benzol, until the substance was administered to animals experimentally. Yet a definite reaction at once proceeds when that substance is introduced into the body. It is linked up, as we have seen, with cystein. Now, this reaction is not one which would proceed in the body uncatalysed; if it be catalysed by an enzyme, all that we know about the specificity of such agents would suggest that a new one must appear for the purpose. I have allowed myself to go beyond ascertained facts in dealing with this last point. But once we have granted that specific enzymes are real agents in the cell, controlling a great number of reactions, I can see no logical reason for supposing that a different class of mechanism can be concerned with any particular reaction.

If we are entitled to conceive of so large a part of the chemical dynamics of the cell as comprising simple metaplasmic reactions catalysed by independent specific enzymes, it is certain that our pure chemical studies of the happenings in tissue extracts, expressed cell juices, and the like, gain enormously in meaning and significance. We make a real step forward when we escape from the vagueness which attaches to the "bioplasmic molecule" considered as the seat of all change. But I am not so foolish as to urge that the step is one towards obvious simplicity in our views concerning the cell. For what indeed are we to think of a chemical system in which so great an array of distinct catalysing agents is present or potentially present; a system, I would add, which when disturbed by the entry of a foreign substance regains its equilibrium through the agency of new-born catalysts adjusted to entirely new reactions? Here seems justification enough for the vitalistic view that events in the living cell are determined by final as well as by proximate causes, that its constitution has reference to the future as well as the past. But how can we conceive that any event called forth in any system by the entry of a simple molecule, an event related qualitatively to the structure of that molecule, can be of other than a chemical nature? The very complexity, therefore, which is apparent in the catalytic phenomena of the cell to my mind indicates that we must have here a case of what Henri Poincaré has called *la simplicité cachée*. Underlying the extreme complexity we may discover a simplicity which now escapes us. If so, I have of course no idea along what lines we are to reach the discovery of that simplicity, but I am sure the subject should attract the contemplative chemist, and especially him who is interested and versed in the dynamical side of his subject. If he can arrive at any hypothesis sufficiently general to direct research he will have opened a new chapter of organic chemistry—almost will he have created a new chemistry.

It must not be supposed that I am blind to the fact that the phenomena of the cell present a side to which the considerations I have put before you do not apply. Paul Ehrlich, in his recent illuminating address to the International Congress of Medicine, remarked that if, in chemistry, it be true that *Corpora non agunt nisi liquida,* then, in chemiotherapy, it is no less true that *Corpora non agunt nisi fixata.* Whatever precisely may be involved in the important principle of "fixation" as applied to drug actions, it remains, I think, true that the older adage applies to the dynamic *reactions* which occur in the living cell. But there are doubtless dynamic phenomena in which the cell complexes play a prominent part. The whole of our doctrine concerning the reaction of the body to the toxins of disease is based upon the fact that when the cell is invaded by complexes other than those normal to it, its own complexes become involved. I must not attempt to deal with these phenomena, but rather proceed to my closing remarks. I would like, however, just to express the hope that the chemist will recognise their theoretical importance. He will not, indeed, be surprised at the oligo-dynamic aspects of the phenomena, startling as they are. When physico-chemical factors enter into a phenomenon the influence of an infinitely small amount of material may always be expected. It is a fact, for instance, as Dr. W. H. Mills reminds me, that when a substance crystallises in more than one form it may be quite impossible to obtain the less stable forms of its crystals in any laboratory which has been "infected" with the more stable form, even though this infection has been produced by quite ordinary manipulations dealing with the latter. Here, certainly, is a case in which the influence of the infinitesimal is before us. But what I feel should arrest the interest of the chemist is the remarkable mingling of the general with the particular which phenomena like those of immunity display. In the relations which obtain between toxin and anti-toxin, for example, we find that physico-chemical factors predominate, and yet they are associated to a high degree with the character of specificity. The colloid state of matter, as such, and the properties of surface determine many of the characteristics of such reactions, yet the chemical aspect is always to the front. Combinations are observed which do not seem to be chemical compounds, but rather associations by adsorption; yet the mutual relations between the interacting complexes are in the highest degree discriminative and specific. The chemical factor in adsorption phenomena has, of course, been recognised elsewhere; but in biology it is particularly striking. Theoretical chemistry must hasten to take account of it. The modern developments in the study of valency probably constitute a step in this direction.

It is clear to everyone that the physical chemist is playing, and will continue to play, a most important part in the investigation of biological phenomena. We need, I think, have no doubt that in this country he will turn to our problems, for the kind of work he has to do seems to suit our national tastes and talents, and the biologist just now is much alive to the value of his results. But I rather feel that the organic chemist needs more wooing and gets less, though I am sure that his aid is equally necessary. In connection with most biological problems, physical and organic chemists have clearly defined tasks. To take one instance. In muscle phenomena it is becoming every day clearer that the mechanico-motor properties of the tissue, its changes of tension, its contraction and relaxation, depend upon physico-chemical phenomena associated with its colloidal complexes and its intimate structure. Changes in hydrogen-ion concentration and in the concentration of electrolytes generally, by acting upon surfaces or by upsetting osmotic equilibria, seem to be the determining causes of muscular movement. Yet the energy of the muscle is continuously supplied by the progress of organic reactions, and for a full understanding of events we need to know every detail of their course. Here then, as everywhere else, is the need for the organic chemist.

But I would urge upon any young chemist who thinks of occupying himself with biological problems the necessity for submitting for a year or two to a second discipline. If he merely migrate to a biological institute, prepared to determine the constitution of new products from the animal and study their reactions *in vitro,* he will be a very useful and acceptable person, but he will not become a biochemist. We want to learn how reactions run in the organism, and there is abundant evidence to show how little a mere knowledge of the constitution of substances, and a consideration of laboratory possibilities, can help on such knowledge. The animal body usually does the unexpected.

But if the organic chemist will get into touch with the animal, it is sure that the possession of his special knowledge will serve him well. Difficulties and peculiarities in connection with technique may lead the professor of pure chemistry to call his work amateurish, and certainly his results, unlike those of the physical chemist, will not straightway lend themselves to mathematical treatment. He may himself, too, meet from time to time the spectre of Vitalism, and be led quite unjustifiably to wonder whether all his work may not be wide of the mark. But if he will first obtain for us a further supply of valuable qualitative facts concerning the reactions in the body, we may then say to him, as Tranio said to his master:

> "The mathematics and the metaphysics
> Fall to them as you find your stomach serves you."

All of us who are engaged in applying chemistry and physics to the study of living phenomena are apt to be posed with questions as to our goal, although we have but just set out on our journey. It seems to me that we should be content to believe that we shall ultimately be able at least to describe the living animal in the sense that the morphologist has described the dead; if such descriptions do not amount to final explanations, it is not our fault. If in "life" there be some final residuum fated always to elude our methods, there is always the comforting truth to which Robert Louis Stevenson gave perhaps the finest expression, when he wrote:

> "To travel hopefully is better than to arrive,
> And the true success is labour."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Leeds.—An anonymous donor has generously signified, through the Chancellor (the Duke of Devonshire), his intention of presenting to the University of Leeds the sum of 10,000*l.* for the erection of the much-needed building for the school of agriculture at the University. This gift will enable the University, in conjunction with the Yorkshire Council for Agricultural Education and with the help, it is hoped, of a grant from the Government, to provide without further delay the headquarters of agricultural education and research for the three Ridings of Yorkshire. The organisation of agricultural teaching in Yorkshire has been taken by the Board of Agriculture as the model for all other parts of England, and the rapid growth of the agricultural courses and the development of research in animal nutrition and other subjects have made it necessary to provide new buildings and laboratories on an extensive scale for the school of agriculture at the University of Leeds. The University Council has provided a site for the new building, and much of the experimental work will be done at the Manor Farm, Garforth.

Manchester.—Mr. A. R. Wardle, assistant demonstrator in zoology in the Royal College of Science, London, has been appointed lecturer in economic zoology in succession to Mr. J. Mangan, who resigned at the end of last session to take up the position of assistant to the professor of biology in the Government Medical College, Cairo.

Mr. W. McBretney, headmaster of the Storey Institute, Lancaster, has been appointed headmaster of the new Secondary School and Technical Institute at Wallsend.

Four Gresham Lectures on Harvey, Darwin, and Huxley will be delivered on October 28, 29, 30, and 31, by Dr. F. M. Sandwith, Gresham professor of physic. The lectures, which will be given at the City of London School, Victoria Embankment, E.C., are free to the public, and will begin each evening at six o'clock.

It is stated in *Science* that M. Ernest Solvay, the discoverer of the Solvay process for the manufacture of sodium carbonate, celebrated the fiftieth anniversary of that discovery on September 2 last at Brussels by giving more than 200,000*l.* to educational and charitable institutions and the employees of his firm. The Universities of Paris and Nancy each received 20,000*l.*

The new engineering laboratories at University College, Dundee, were opened on October 14, by Sir Alexander Kennedy, F.R.S. The chair of engineering was one of the first to be established at Dundee University College, and in 1882, Prof. (now Sir Alfred) Ewing, K.C.B., was elected as its first occupant. For some few years after the foundation of the college, the facilities for the experimental teaching of engineering were meagre, and it was not until 1887 that an engineering laboratory on an adequate scale was provided. In January, 1911, the University authorities decided to build and equip a new engineering block, utilising for the purpose a grant of 10,000*l.* made by the Carnegie Trust for the development of the Scottish Universities. This department has been erected at a cost, including equipment, of about 15,500*l.* Owing to the completion in 1910 of the Peters's Electrical Engineering Laboratory, the college is well equipped for the study of this branch of engineering, and the present laboratories are devoted to the investigation of problems involved in civil and mechanical engineering. The heat-engine equipment at present includes an experimental steam engine, a gas engine, and a petrol motor, while provision is made for the installation of a Diesel oil engine and a steam turbine in the near future. The heat engine-room also contains all the apparatus necessary for the measurement of the heat value of solid and gaseous fuels, for the analysis of flue, exhaust, and fuel gases, and for the measurement of the dryness of steam, &c. The equipment of the strength of materials laboratory consists of a 50-ton Buckton single-lever testing machine, fitted for tension, compression, and cross-breaking, and with autographic recorder, an alternating stress machine, and cement testing machine, along with apparatus for determining the moduli of elasticity and rigidity, and for investigating the strength of struts and the elastic vibrations and deformations of structures. The hydraulic equipment includes a 24-in. Pelton wheel, a 9-in. inward flow pressure turbine, an electrically-driven centrifugal pump, capable of discharging 450 gallons per minute, an Oddie-Barclay high-speed differential-ram reciprocating pump, a flume, 3 ft. broad and 45 ft. long, for the study of weir and channel flow, and apparatus for studying the friction of fluids in pipes, the impact of jets, &c.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, September 29.—M. C. Jordan in the chair.—J. **Guillaume**: Observation of the occultation of the Pleiades by the moon, made September 20, 1913, with the *coudé* equatorial at Lyons Observatory.—Léopold **Fejér**: Harmonic polynomials.—H. **Tietze**: Continuous representations of surfaces on themselves.—C. **Beau**: The relations between tuberisation of roots and the attack by endophytic fungi in the course of development of *Spiranthes autumnalis*.

October 6.—M. P. Appell in the chair.—H. **Deslandres**: Remarks on the general electric and magnetic fields of the sun. A full discussion of the work of Hale in comparison with that done at Meudon by the author.—A. **Chauveau**: A comparison of human and bovine tuberculosis from the point of view of innate or specific aptitude of receiving or cultivating the bacillus. A development of views put forward in an earlier paper. The author holds that no human being, whatever the state of health, is incapable of receiving the tubercle infection, and regards this as a necessary consequence of his experiments on cattle. In the case of human beings exposed to infection and escaping, it is not the stronger subjects alone who escape. The practical conclusion is drawn that in the battle against tuberculosis, it is the bacillus which must be attacked, and hence that concentration on strengthening the vitality of the possible patient is unscientific.—R. **Lépine** and M. **Boulud**: The origin of the sugar secreted in phlorizic glycosuria. The results of experiments are cited contradicting the hypothesis that the sugar eliminated in phlorizic glycosuria arises from the renal cells. The point of attack in the kidney appears to be especially the vascular endothelium.—Charles **Depéret**: The fluvial and glacial history of the Rhône valley in the neighbourhood of Lyons. The Rhône glacier reached the Lyons region at a later period than the Quaternary epoch.—J. **Bosler**: The spectrum of the Metcalf comet, 1913*b*. Photographs taken at Meudon show a feeble continuous spectrum with three condensations corresponding to hydrocarbons (Swan spectrum) and cyanogen. It is nearly identical with the spectrum of the Schaumasse comet.—Michel **Plancherel**: The convergence of series of orthogonal functions.—Georges **Rémoundos**: Families of multiform functions admitting exceptional values within a domain.—Emile **Jouguet**: Some properties of waves of shock and combustion.—Léon **Guillet** and Victor **Bernard**: The variation of the resilience of some commercial alloys of copper as a function of the temperature. The alloys examined included seven bronzes with tin, ranging from 3·5 per cent. to 20 per cent., four brasses, and one aluminium bronze. The results are given graphically in two diagrams.—Charles **Nicolle** and L. **Blaizot**: An atoxic antigonococcic vaccine. Its application to the treatment of blennorrhagia and its complications. The authors have obtained a stable, atoxic antigonococcic serum by a method not disclosed, and give details of its curative action in a considerable number of cases.—Ch. **Dhéré** and A. **Burdel**: The absorption of the visible rays by the oxyhæmocyanines. Three reproductions of photographs of spectra are given. There would appear to be one absorption band common to all the oxyhæmocyanines.—M. de Montessus de **Ballore**: An attempt at synthesis of seismic and volcanic phenomena.—Ph. **Flajolet**: Observation of a curious formation of cirrus.

New South Wales.

Linnean Society, August 27.—Mr. W. W. Froggatt, vice-president, in the chair.—A. M. **Lea**: Revision of the Australian Curculionidæ belonging to the subfamily Cryptorhynchides, Part xii. This paper deals with the balance of the genera, more particularly those allied to Poropterus, and species of this immense subfamily of weevils, and, with the exception of a concluding instalment dealing with the classification, distribution, &c., is the last of the series. Fifteen genera (one proposed as new) and twenty-three species (two proposed as new) are described.—W. N. **Benson**: The geology and petrology of the Great Serpentine Belt of New South Wales, Part i., Introductory. The area described stretches from Warialda to Tamworth, embracing about 2000 square miles, together with one hundred square miles in the Nundle district, S.S.E. of Tamworth. A general description of the palæozoic formations is given. A great extension of the radiolarian rocks has been proved, both laterally and in vertical range. The sequence in igneous rocks is sketched.

BOOKS RECEIVED.

Preliminary Geography. By E. G. Hodgkinson. Pp. xvi+225. (London: W. B. Clive.) 1*s*. 6*d*.

Memoirs of the Department of Agriculture in India. Botanical Series. Vol. vi., No. 3. Studies in Indian Tobaccos, No. 3. The Inheritance in Nicotiana of Characters Tabacum, L. By G. L. C. Howard. Pp. 25–115+plates. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 3 rupees.

Die Luftfahrt. Ihre Wissenschaftlichen Grundlagen und Technische Entwicklung. By Dr. R. Nimführ. Dritte Auflage. Pp. viii+132. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Experimental-Zoologie. By Dr. Hans Przibram. 4. Vitalität. (Lebenszustand.) Pp. viii+179+x plates. (Leipzig and Wien: F. Denticke.) 10 marks.

The Latest Light on Bible Lands. By P. S. P. Handcock. Pp. xii+371. (London: S.P.C.K.) 6*s*. net.

A First Book on Practical Mathematics. By T. S. Usherwood and C. J. A. Trimble. Pp. v+182. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

Practical Geometry and Graphics for Advanced Students. By Prof. J. Harrison and G. A. Baxandall. Enlarged edition. Pp. xiv+677. (London: Macmillan and Co., Ltd.) 6*s*.

Proceedings of the Edinburgh Mathematical Society. Vol. xxxi. Session 1912–1913. Pp. 110. (Edinburgh: Mathematical Society and Lindsay and Co.) 7*s*. 6*d*.

The Twisted Cubic. With some Account of the Metrical Properties of the Cubical Hyperbola. By P. W. Wood. Pp. x+78. (Cambridge: University Press.) 2*s*. 6*d*. net.

The Physician in English History. (Linacre Lecture, 1913, St. John's College, Cambridge.) By Dr. N. Moore. Pp. 57. (Cambridge: University Press.) 2*s*. 6*d*. net.

The Bacteriology of Diphtheria. Including Sections on the History, Epidemiology and Pathology of the Disease, the Mortality Caused by it, the Toxins and Antitoxins, and the Serum Disease. Edited by Dr. F. Loeffler, Dr. A. Newsholme, and others. Re-issue, with Supplementary Bibliography. Pp. xx+718+xvi plates. (Cambridge: University Press.) 15*s*. net.

Notes on the Natural History of Common British Animals and some of their Foreign Relations. Vertebrates. By Kate M. Hall. Pp. xii+289. (London: Adlard and Son.) 3*s*. 6*d*. net

Ulster Folklore. By Elizabeth Andrews. Pp. xiii+121+xii plates. (London: Elliot Stock.) 5*s*. net.

Japan's Inheritance. The Country, its People, and their Destiny. By E. Bruce Mitford. Pp. 384+plates. (London and Leipsic: T. Fisher Unwin.) 10*s*. 6*d*. net.

The Vulgate Version of the Arthurian Romances. Edited from manuscripts in the British Museum by H. O. Sommer. Vol. vii. Supplement, Le Livre D'Artus. Pp. 370. (Washington, U.S.A.: Carnegie Institution.)

Penmo-Carboniferous Vertebrates from New Mexico. By E. C. Case, S. W. Williston, and M. G. Mehl. Pp. v+81. (Washington, U.S.A.: Carnegie Institution.)

Igneous Rocks. Composition, Texture and Classification, Description and Occurrence. By J. P. Iddings. Vol. ii. Pp. xi+685. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 25*s*. 6*d*. net.

The Theory of Relativity. By Prof. R. D. Carmichael. Pp. 74. (Mathematical Monographs.) (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

Elements of Water Bacteriology. By Prof. S. C. Prescott and Prof. C. E. A. Winslow. Third edition. Pp. xiv+318. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net.

My Game-Book. By A. R. Haig Brown. Pp. xvi+239. (London: Witherby and Co.) 5*s*. net.

Untersuchungen über Chlorophyll. Methoden und Ergebnisse. By R. Willstätter and A. Stoll. Pp. viii+424+xi plates. (Berlin: J. Springer.) 18 marks.

Department of Commerce. U.S. Coast and Geodetic Survey. Results of Observations made at the U.S. Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, 1911 and 1912. By D. L. Hazard. Pp. 98+plates. (Washington, U.S.A.: Government Printing Office.)

Department of the Interior. U.S. Geological Survey. Professional Paper 78. Geology and Ore Deposits of the Philipsburg Quadrangle, Montana. By W. H. Emmons and F. C. Calkins. Pp. 271+xvii. Professional Paper 80. Geology and Ore Deposits of the San Francisco and Adjacent Districts, Utah. By B. S. Butler. Pp. 212+xl plates. (Washington, U.S.A.: Government Printing Office.)

Outlines of Mineralogy for Geological Students. By Prof. G. A. J. Cole. Pp. viii+339. (London: Longmans, Green and Co.) 5*s*. net.

A Day in the Moon. By the Abbé Th. Moreux. Pp. viii+199+plates. (London: Hutchinson and Co.) 3*s*. 6*d*. net.

Electric Circuit Theory and Calculations. By W. Perren Maycock. Pp. xiv+355. (London and New York: Whittaker and Co.) 3*s*. 6*d*. net.

Anleitung zur Darstellung phytochemischer Uebungspräparate für Pharmazeuten, Chemiker, Technologen u.a. By Dr. D. H. Wester. Pp. xi+129. (Berlin: J. Springer.) 3.60 marks.

The Principles and Practice of Medical Hydrology: being the Science of Treatment by Waters and Baths.

By Dr. R. F. Fox. Pp. xiv+295. (London: University of London Press.) 6s. net.

The Annual of the British School at Athens. No. XVIII. Session 1911–12. Pp. viii+362+xv plates. (London: Macmillan and Co., Ltd.) 25s. net.

Modern Substitutes for Traditional Christianity. By E. McClure. Pp. vii+145. (London: S.P.C.K.) 2s. net.

The Nature and Origin of Fiords. By Dr. J. W. Gregory, F.R.S. Pp. xvi+542+viii plates. (London: John Murray.) 16s. net.

Mechanism, Life and Personality. An Examination of the Mechanistic Theory of Life and Mind. By Dr. J. S. Haldane, F.R.S. Pp. vii+139. (London: J. Murray.) 2s. 6d. net.

A History of the Royal Society of Arts. By Sir Henry T. Wood. Pp. xviii+558+plates. (London: J. Murray.) 15s. net.

The Continent of Europe. By Prof. L. W. Lyde. Pp. xv+446+maps. (London: Macmillan and Co., Ltd.) 7s. 6d. net.

Exercises d'Arithmétique. Enoncés et Solutions. By J. Fitz-Patrick. Troisième édition. (Paris: A. Hermann et Fils.) 12 francs.

Théorie des Nombres. By E. Cahen. Tome Premier. Le Premier Degré. Pp. xii+408. (Paris: A. Hermann et Fils.)

Les Principes de l'Analyse Mathématique. Exposé Historique et Critique. By Prof. P. Boutroux. Tome Premier. Pp. xi+547. (Paris: A. Hermann et Fils.) 11 francs

Leçons sur la Dynamique des Systèmes Matériels. By Prof. E. Delassus. Pp. xii+421. (Paris: A. Hermann et Fils.) 14 francs.

The Manchester Municipal School of Technology. Calendar, 1913–14. (Manchester.)

Canada. Department of Mines. Geological Survey. Memoir No. 33. The Geology of Gowganda Mining Division. By W. H. Collins. Pp. vii+121+iv plates. Memoir No. 29-E. Oil and Gas Prospects of the North-west Provinces of Canada. By W. Malcolm. Pp. vi+99+ix plates. (Ottawa: Government Printing Bureau.)

Journal of the College of Science, Imperial University of Tokyo. Vol. xxxiii., Art. 1. A Catalogue of the Fishes of Japan. By D. S. Jordan, S. Tanaka, and J. O. Snyder. Pp. 497. (Tokyo: The University.)

Lebensgewohnheiten und Instinkte der Insekten bis zum Erwachen der sozialen Instinkte. By Prof. O. M. Reuter. Vom Verfasser revidierte Uebersetzung nach dem schwedischen Manuskript. By A. u. M. Buch. Pp. xvi+448. (Berlin: R. Friedlander und Sohn.) 16 marks.

Das Tierreich. 39 Lieferung. Cumacea (Sympoda). By the Rev. T. R. R. Stebbing. Pp. xvi+210. (Berlin: R. Friedlander und Sohn.) 16 marks.

The University of Sheffield. Calendar for the Session 1913–14. Vol. i. (Sheffield.)

Lip-Reading: Principles and Practise. By E. B. Nitchie. Pp. xiv+324. (London; Methuen and Co., Ltd.) 5s. net.

Tasmania. Department of Mines. Geological Survey Bulletin, No. 13. The Preolenna Coal Field and the Geology of the Wynyard District. By L. Hills. Pp. 69. (Tasmania.)

New Zealand. Dominion Museum, Bulletin No. 4. The Stone Implements of the Maori. By E. Best. Pp. 410+li plates. (Wellington.)

DIARY OF SOCIETIES.

THURSDAY, OCTOBER 16.

INSTITUTION OF MINING AND METALLURGY, at 8.—Laterization in Minas Geraes, Brazil: J. H. Goodchild.—An Example of Secondary Enrichment: W. F. A. Thomae.—The Effect of Charcoal on Gold-Bearing Cyanide Solutions with Reference to the Precipitation of Gold: Morris Green.

FRIDAY, OCTOBER 17.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Education; some Random Reflections: G. Evetts.

THURSDAY, OCTOBER 23.

INSTITUTION OF CIVIL ENGINEERS, at 9.—Progress of Marine Construction: Alex. Gracie.

FRIDAY, OCTOBER 24.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Modern Flour Milling Machinery: R. B. Creak.

PHYSICAL SOCIETY, at 5.—The Ice Calorimeter: E. Griffiths.—An Electrostatic Oscillograph: H. Ho and S. Kotô.

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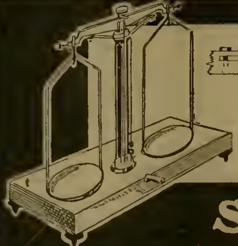

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A Course of four Lectures on "The Cerebro-spinal Fluid," by Professor W. D. Halliburton, F.R.S., and Professor W. E. Dixon, F.R.S., jointly, at King's College, Strand, W.C., on Mondays, November 3, 10, 17, and 24, 1913, at 4.30 p.m.

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THURSDAY, OCTOBER 23, 1913.

LORD RAYLEIGH'S SCIENTIFIC PAPERS.

Scientific Papers. By John William Strutt, Baron Rayleigh, O.M., F.R.S. Vol. v., 1902–1910. Pp. xiii+624. (Cambridge University Press, 1912.) Price 15*s*. net.

THE fifth volume of Lord Rayleigh's papers contains his researches from 1902 to 1910; it is a volume of nearly eighty papers on subjects of a very varied nature—no slight record for a man during the seventieth decade of his life.

The four earlier volumes of the work have already been noticed in NATURE, and there is little more to be said with regard to the volume now under review.

The thanks of all interested in the advance of physical science are due in the first place to the author for thus reissuing in collected form his work during his own lifetime, and in the second to the Cambridge University Press for publishing it in the present admirable form. The issue of the collected works of great mathematicians—Adams, Cayley, Maxwell, Stokes, Rayleigh, Tait, and Kelvin—which the Press has undertaken in recent years has been of the utmost value to students throughout the world; and of this series no volumes have been more eagerly looked for or met with a more welcome reception than those of Lord Rayleigh. The pages under review afford ample evidence of the author's special powers, clearness of vision, whether in regard to the mathematical theory of his subject or to the essential details of an experimental inquiry; a firm grasp of mathematics as an instrument to solve the problem he is attacking; readiness to use simple methods of experiment where these suffice; the power to see when it is necessary to call in the highest skill of the instrument-maker or the minute care of the observer—these are manifest throughout.

It must suffice for the present to refer to one or two of the papers which appear of most interest to the present writer; the volume must find a place on the shelves of every physical library, and be continually referred to by students and workers.

One of the earliest papers reprinted from the Phil. Trans. for 1902 deals with the isothermal relation between the pressure and volume of a gas at pressures of from 75 to 150 mm. of mercury. The conclusion reached is that to one part in 5000 at least air, hydrogen, oxygen, and argon obey Boyle's law at the pressures concerned and at ordinary temperatures ($10^\circ - 15^\circ$). For nitrous oxide the deviations are somewhat greater. The work was extended to higher pressures up to one atmosphere in a further paper (Phil. Trans., 1905).

In two interesting papers the question whether the earth's motion affects the rotatory polarisation or produces double refraction of light are both answered in the negative. Other papers, again, bear evidence as to Lord Rayleigh's activity as a member of the Explosives Committee, or as adviser to the Trinity House, while a large part of the volume deals with various problems of small vibrations either optical, acoustical, or electrical, *e.g.* on the bending of waves round a spherical obstacle; on the dynamical theory of gratings; on the application of Poisson's formula to discontinuous disturbances, together with a series of acoustical notes.

Reference should also be made to a series of papers dealing with the measurement of the wave-length of light, commencing with one in the *Philosophical Magazine* for 1906, on some measurements of wave-lengths with a modified apparatus, followed by another on further measurements of wave-lengths, *Phil. Mag.*, xv., 1908. Both these papers are admirable examples of Lord Rayleigh's method of dealing with experimental difficulties of a high order without any undue elaboration of apparatus, and of his success in securing results. The method employed was a modification of that of Fabry and Perot, and the observations recorded in the first paper verified to one part in a million the values found for the wave-lengths, in terms of that of the red cadmium line, of the more important lines of cadmium, mercury, zinc, and soda, by Michelson and Fabry and Perot.

In conclusion reference should be made to papers on skin friction on even surfaces, a note to a paper by Prof Zahm, *Phil. Mag.*, 1904, and on the application of the principle of dynamical similarity, Reports of the Advisory Committee for Aëronautics, 1909–10 and 1910–11.

These deal with the conditions to be observed when calculating the resistance on bodies moving through the air from experiments on models. On the assumption that the resistance depends on the velocity and viscosity of the air and on the size of the surface, and is approximately proportional to the square of the velocity, it is shown that the resistance R is given by the equation—

$$R = \rho V^2 f(\nu/Vl),$$

where ρ, V, and ν are the density, velocity, and viscosity of the fluid, and l a linear quantity defining the size of the body, f being an unknown function. It follows from this that if the resistances are to be treated as proportional to the squares of the velocities for the actual body and the model, the comparisons must be made at velocities for which Vl is constant—*i.e.* at velocities inversely proportional to the size of the body and model respectively.

Enough has probably been written to direct attention to the wide range and absorbing interest of the subjects discussed in this volume.

CONCERNING BIRDS.

(1) XI. *Jahresbericht* (1911) *der Vogelwarte Rossitten der Deutschen Ornithologischen Gesellschaft.* Teil II. By Prof. J. Thienemann. Pp. 1–75.

(2) *The Food of some British Wild Birds: a Study in Economic Ornithology.* By W. E. Collinge. Pp. vi+109. (London: Dulau and Co., Ltd., 1913.) Price 4*s.* net.

(3) *The Bodley Head Natural History.* By E. D. Cuming. With Illustrations by J. A. Shepherd. Vol. i., British Birds. Passeres. Pp. 120. (London: John Lane, 1913.) Price 2s. net.

(1) IN the second part of the eleventh annual report of the "Vogelwarte," or bird-watching station, at Rossitten in East Prussia, Dr. Thienemann sets forth the 1911 results of the migration inquiry. The method pursued is marking the birds with numbered and addressed rings, and it continues to yield very interesting results. We notice that more than one black-headed gull born near Rossitten has been recovered in England, and a starling marked in the nest in Livonia on June 10, 1911, was shot on December 26, 1911, near Buckfast Abbey, South Devon. Other black-headed gulls from Rossitten were reported from Hungary, Croatia, Switzerland, and Piedmont; and one marked at Munich was found again at Tunis. Best of all is the case of a Rossitten gull marked in the nest July 18, 1911, and shot in November in Barbadoes. We may recall the fact that a British marked gull has been reported from the Azores.

Some new records of German storks from Africa bring the total of such cases up to twenty-four. They include recoveries from the Mbomu-Ubangi basin (North Congo), German East Africa, and the Victoria East district of Cape Province (the southernmost locality, 32° 46′ S.). Interest also attaches to storks recovered in Europe, for while most of those from Germany (east and west), Denmark, and Holland have been found to migrate south-eastwards towards Asia Minor on their way to Egypt and further south, we have a second case of a West German stork migrating towards Spain.

It is difficult to pick and choose among the interesting records, such as three hooded crows recovered after intervals of more than six years; a lesser black-backed gull marked at Rossitten in autumn and reported from Servia after three weeks; a young woodcock marked near St. Petersburg, July 3, 1911, recovered in dept. Gers, S.W. France, December 12, 1911; a wood pigeon marked in the nest near Dresden and obtained five months later in dept. Lot-et-Garonne, S.W. France; a rough-legged buzzard marked in the nest in northern Swedish-Lapland in July, and shot near Vienna four and a-half months later; an eagle (*A. pomarina*) marked in the nest in Russian Kurland in July, and recovered two months afterwards in Southern Bulgaria. A discussion of certain rather puzzling movements of the red-legged falcon concludes this interesting paper. Dr. Thienemann is to be heartily congratulated on the success which has attended the inquiry which he so energetically pursues.

(2) Mr. Collinge has done a very useful piece of work in presenting in compact form the results of his *post-mortem* examination of 3048 adult birds and 312 nestlings, and in giving along with this an up-to-date summary of what is known in regard to the food of the commonest British birds. We do not speak without feeling when we say that it is no light task to examine the food-canals of 3000 birds, and to make sure, or as sure as one can, of the significance of their imperfectly preserved contents. Mr. Collinge has done his work carefully, and the results are proportionately valuable—helping us, none too soon, to get away from the practical mistakes engendered by prejudice and hearsay evidence. Mr. Collinge has also been careful in his presentation of the work done by other observers.

Attention may be directed to the interesting (but all too short) chapters on the food of nestlings, on the *rôle* of birds in destroying or distributing the seeds of weeds, and on the relation of birds to forestry. Of the twenty-nine species of birds which have been especially studied by the author, only five are regarded as distinctively injurious, viz., the house-sparrow, bullfinch, sparrow-hawk, wood pigeon, and stockdove; six are regarded as altogether too plentiful, and consequently injurious, viz., missel thrush, blackbird, greenfinch, chaffinch, starling, and rook; the blackcap is injurious, but not plentiful; the jay is held to be neutral; and the remaining sixteen are beneficial, most of them meriting protection, especially the owls, the wren, and the plover. It must be borne in mind, however, that these are average verdicts, and Mr. Collinge would doubtless agree that they require modification for different parts of the country. The book does not deal at all with fish-eating birds, in regard to some of which there is a warm difference of opinion—to be settled by gathering more facts

—between the champions of birds on one hand and angling associations on the other. We hope this book will pass through many editions, and gain in strength as it grows—incorporating new data and extending its scope.

(3) Of making books—big and little—about birds there is no end, and the more the merrier as long as each newcomer is accurate and sincere, with something fresh to reveal. There is no doubt of a welcome for the "Bodley Head" bird-book, for Mr. Shepherd's drawings are charming characterisations, quite unusually successful in revealing the ways and habits of the birds. There is a good deal of psychology in them. The text is pleasantly and clearly written, without waste of words, and with insight into what is most distinctive. We would suggest that the inclusion of rarities, such as the rose-coloured pastor, is uncalled for in a book of this kind.

NEW AMERICAN BOOKS ON AGRICULTURE.

(1) *Cooperation in Agriculture.* By G. H. Powell. Pp. xv+327+xvi plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s*. 6*d*. net.

(2) *The Farmer of To-morrow.* By F. I. Anderson. Pp. viii+308. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s*. 6*d*. net.

(3) *Animal Husbandry for Schools.* By Prof. M. W. Harper. Pp. xxii+409. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s*. net.

(4) *Elementary Tropical Agriculture.* By W. H. Johnson. Pp. xi+150. (London: Crosby Lockwood and Son, 1913.) Price 3*s*. 6*d*. net.

(1) THE first book on the list contains a very interesting account of the cooperative movement in America, especially as applied to agriculture. The subject is a very difficult one, and the author shows in his opening pages that he is fully aware of the intricacies and pitfalls in which it abounds. In the first instance a cooperative movement is not necessarily organised for the sake of profit; it may also be—and is, indeed, primarily—run for the benefit of its members in other directions. Secondly, as the author brings out very vividly, the average farmer is not a specialist. He produces a variety of general crops, each of which has to be handled and marketed through different agencies. Moreover, the supplies he uses are secured from different sources. He is thus in an entirely different position from the specialist farmer, who devotes his main attention to some one crop, such as apples, potatoes, &c., and therefore has much in common with others who are in the same line of business. These men can easily combine; they have to face the same problems of production, transport, distribution, and sale. Everywhere it is found that cooperation is easier for them than for the ordinary farmer.

The author therefore considers it a fundamental principle that a successful industrial organisation among farmers must be founded on a special industry, such as cotton, tobacco, milk, &c. Further, that the unit must lie in a restricted area. It also seems necessary for success that the organisation must be born in times of adversity; if it springs up in times of prosperity it has less chance of surviving the competition of existing agencies. Having laid down these fundamental principles, the author proceeds to show what has been done in the various States to apply them to the case of the ordinary farmer producing various crops.

(2) In this book Mr. Anderson gives a vivid account of the problem of soil fertility as it is understood by the Bureau of Soils at Washington. It is written in the direct popular style that is being cultivated with marked success by some of the present American authors, and it gives a very lively picture of the work done by the Bureau and its bearing on present-day agricultural problems in America. The author does not attempt any discussion of the hypotheses, and his statement of the position of the other side is somewhat inaccurate; in a popular book, however, it is something if the other side is recognised at all, even though it is only set up to be knocked over.

Besides all this there is a very spirited account of the position of American agriculture to-day, the movement back to the land, the introduction of business methods, the rise in capital value of the land, and the question of soil treatment. All these matters are dealt with in a light and easy fashion which cannot fail to hold the reader's interest.

(3) The third book on the list is one of the Rural Text-book Series, and is designed for schools and for short-course students at the colleges. It is thoroughly worthy of its companions in the series. The descriptions of the animals are good, and the illustrations are both adequate and to the point. The general reader will be struck by the large part British live stock play in the animal husbandry of the United States. After an enumeration of the different breeds, the author passes on to the methods of judging. The animal's mouth affords useful guidance here, and some good illustrations are given showing the appearance of the teeth at different ages. Next follows a detailed description of the score card, an American invention of great value that has now found its way into English colleges.

The selection of animals to be fattened is no longer a haphazard matter. Farmers and graziers have learnt by experience that animals which fatten well possess certain points in common. Thus a good beef steer for fattening has a head with definite characteristics, which are thus set out by the author :—

"It should be broad and short, the face and cheeks should be full and deep with a broad, strong lower jaw. The nostrils should be large. The eyes should be large, prominent, and mild, indicating a quiet temperament. The forehead should be somewhat prominent, and covered with a mass of wavy hair. The ear should be of medium size, and covered inside and out with fine silky hair, and should be neatly attached to the head."

The other parts of the body have to be observed in similar detail. It would be interesting to inquire how far these "points" possess any real significance, and how far they are purely fanciful. Although the author does not help us in this matter, he has done good service by placing on record the points recognised in American practice.

(4) Mr. Johnson has gathered together in this little book—the only British book on the list—the main principles involved in tropical agriculture, with a view to the introduction of the subject into schools. He is convinced that West African youths must be encouraged to adopt agriculture as a profession if the immense potential agricultural wealth of the country is to be extensively developed; he considers that the unhealthiness of the climate must militate against the direct exploitation of the industry by Europeans. This being so, it is obviously necessary that the principles of agriculture should be introduced into West African schools, and the book is intended for this purpose. It begins with a chapter on soil, then with six chapters on the plant, dealing respectively with the seed, the root, the stem, leaves, the flower, and the fruit. Next follows an account of the food of plants, in which the author reverts once more to the soil. Two chapters on diseases and insect pests come next, and finally there is a section dealing with the school garden. The book is well got up, and is clearly written; it should serve very well the purpose for which it is intended.

THE POPULARISATION OF SCIENCE.

Harmsworth Popular Science. Edited by Arthur Mee. In 43 parts. (London: The Amalgamated Press, Ltd.)

THE days when Science was an intellectual preserve for the few are long since past, and popularisation has become an art—increasingly an art. For if we compare a work like that before us with the "Useful Information for the People," or the "Science for All," or the "Popular Educator" of half a century ago, we cannot but admit that popularisation has made strides. The scope is more ambitious, bigger and deeper subjects are tackled; the mode of presentation is more interesting, which implies greater psychological skill; the style tends to be clearer, more vivid, less wordy; the illustrations are often extraordinarily educative; and the whole thing is more vertebrated. Sometimes it is the evolution-idea that gives unity to the treatment; sometimes it is an enthusiastic conviction that Science is for Man—to aid him to enter into his kingdom; more rarely the unifying aim is to work out a course of intellectual gymnastics—"a brain-stretching discipline."

Those who have listened to fine examples of popular lectures, such as some of the Evening Discourses at the British Association or at the Royal Institution, or who have read Huxley's or Tyndall's, must admit that sound popularisation is possible. If the lecturer has a deep first-hand knowledge of what he is talking about, if he has lucidity, vividness, the teacher's instinct, and a few more gifts and graces, what may he not achieve—as we have seen and heard—in the way of making even a difficult subject luminous to an average intelligence, and that without any lowering of the scientific standard? And if sound popularisation is possible, it is also for many reasons desirable. Knowledge is power: *savoir pour prévoir, et prévoir pour pourvoir*; its increase is an increase not of sorrow to well-constituted minds, but of interest and zest, alleviating what Shakespeare calls "life-harming heaviness"; and thirdly, no one can doubt that one of the most pressing social needs of the age is the better education of the wage-earners, and, of course, of the leisured class as well. Therefore we heartily welcome the extraordinary work before us, because it is sound popularisation, and sometimes reaches a very high level of success.

The book runs to more than 5000 pages, and it has twelve main themes. It tells of other worlds in space, of the making of the earth, of early forms of life, of the pedigree of plants, of the evolution of animals, of the ascent of man, of the laws of health, of the mastery of natural forces, of the rise of industry, of the development of commerce, of the history of society, and of the possible improvement of the race. It is, of course, sketchy, selective, and sometimes a little sensational, but it keeps to the facts, it is written with great skill, and it seems to us a big educational success. There is vitality and earnestness throughout, and the illustrations are exceptionally vivid and arresting. The numerous portraits of scientific workers give a personal touch to the text. We have tried it on a boy of ten and a somewhat *blasé* reader of fifty, and both give the same verdict—that it is extraordinarily interesting. We should like to have seen the authors' names, and we should like to cut the parts and bring, let us say, all the Hygiene together; but these are minor matters. We wish this popularisation all success, because it is sound; and what are the factors in this soundness?

It appears to us that the chief desiderata in an educational enterprise of this sort are the following:—Getting contributors with the gifts and graces already alluded to, plus the crowning humility of taking pains and obeying the editor (to whom our compliments); the good sense not to pretend that everything is easy, since nothing thorough is; the critical faculty of discerning what can be presented accurately, and at the same time intelligibly, for while most true ideas are clear there is a clarity that only dazzles the man in the street; and, last, the restraint which forbids "giving to the ignorant, as a gospel, in the name of Science, the rough guesses of yesterday that to-morrow should forget." We do not mean to suggest that this huge work has all these virtues in perfection, but it has striven after them, and therefore we wish it well.

OUR BOOKSHELF.

Arabische Gnomonik. No. 1. By Dr. Carl Schoy. Pp. 40+2 plates. Aus dem Archiv der Deutschen Seewarte.) (Hamburg, 1913.)

This mathematical account of Moslem dialling, by a writer already known for his studies of Arabic astronomy, forms one of the publications of the Deutsche Seewarte.

The author first touches on the bibliography. There is food for thought in the fact that but two references are given to English writers. The Arabic sun-dial differs from that of the Greeks in having a single point, at the apex of a spike, for index, in place of the gnomon. The horizontal dial is first treated, and rules are given for laying off "temporary hour-lines." These hours, duodecimal subdivisions of the daylight interval, vary in length; nevertheless, their inconvenience did not prevent their universal adoption until the time of Abu'l Hassan, who introduced equal hours about 1200 A.D. They are specially dealt with in the third chapter. The analysis of the clepsydra in this chapter gives unequal hours, since it assumes—erroneously—a constant rate of discharge.

Next follow two chapters on the determination of the Kibla and the times of prayer—sunset, nightfall, dawn, noon, and afternoon (asr). The last, with its various definitions, is discussed in some detail. The closing chapters concern vertical, cylindrical, and conical dials.

Though leaning towards the academic in places (the author employs declinations of 36°, −69°, −45°, and 63° on p. 21), the work is of high interest and much utility to all who have to do with Moslem chronometry. A few typographical errors apart, it is well printed, but an index would have been a useful addition.

J. I. C.

Cotton Spinning. By W. S. Taggart. Vol. I. Including all Processes up to the End of Carding. Pp. xxxvi+262. Fourth edition. Vol. II. Including the Processes up to the End of Fly-frames. Pp. xiv+245. Fifth edition. (London: Macmillan and Co., Ltd., 1913.) Price 4*s*. net each.

These books have been brought up to date, and much new matter and many illustrations have been added. In all essential respects they resemble the previous editions, which have gained a wide circulation among students and practical cotton-spinners.

Modern Problems in Psychiatry. By Prof. Ernesto Lugaro. Translated by Drs. D. Orr and R. G. Rows. With a Foreword by Sir T. S. Clouston. Pp. vii+305. Second edition. (Manchester University Press, 1913.) Price 7*s*. 6*d*. net.

The first English edition of Prof. Lugaro's book was reviewed in the issue of Nature for January 6, 1910 (vol. lxxxii., p. 273). The present issue differs in no important respect from the former; a large number of minor changes, including the correction of several errors, have been made.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Spectra of Helium and Hydrogen.

Recently Prof. Fowler (Month. Not. Roy. Astr. Soc., December, 1912) has observed a number of new lines by passing a condensed discharge through mixtures of hydrogen and helium. Some of these lines coincide closely with lines of the series observed by Pickering in the spectrum of the star ζ Puppis, and attributed to hydrogen in consequence of its simple numerical relation to the ordinary Balmer series. Other lines coincide closely with the series predicted by Rydberg and denoted as the principal series of the hydrogen spectrum. The rest of the new lines show a very simple relation to those of the latter series, but apparently have no place in Rydberg's theory.

From a theory of spectra (*Phil. Mag.*, July, 1913) based on Rutherford's theory of the structure of atoms and Planck's theory of black-radiation, I have been led to the assumption that the new lines observed by Fowler are not due to hydrogen, but that all the lines are due to helium and form a secondary helium spectrum exactly analogous to the ordinary hydrogen spectrum. This view is supported by recent experiments of Mr. Evans (Nature, September 4, p. 5), who observed the line 4686 in a helium tube not showing the ordinary hydrogen lines. Prof. Fowler (Nature, September 25, p. 95), on the other hand, brings forward some objections against the assumption that the lines are due to helium. In his communication Fowler states that the two series of lines, denoted by him as the first and the second principal series of the hydrogen spectrum, in his opinion cannot be united within the limits of error of observation in a single series, such as my theory claims. However, I believe that it is possible on the theory to account for the lines in satisfactory agreement with the measurements.

The first and the second columns of the table below contain the wave-lengths given by Fowler for the new lines and the corresponding limits of error of observation. The lines are marked by P_1, P_2, and S. according as they belong to the first or the second principal series or the Sharp series respectively. The figures in the third column are the products of the wave-lengths and the quantity $\frac{1}{n_1^2} - \frac{1}{n_2^2}$, where n_1 and n_2 are given in the bracket.

	$\lambda \cdot 10^8$	Limit of error	$\lambda\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\cdot 10^{10}$	
P_1	4685·98	0·01	22779·1	(3 : 4)
P_2	3203·30	0·05	22779·0	(3 : 5)
P_1	2733·34	0·05	22777·8	(3 : 6)
P_2	2511·31	0·05	22778·3	(3 : 7)
P_1	2385·47	0·05	22777·9	(3 : 8)
P_2	2306·20	0·10	22777·3	(3 : 9)
P_1	2252·88	0·10	22779·1	(3 : 10)
S	5410·5	1·0	22774	(4 : 7)
S	4541·3	0·25	22777	(4 : 9)
S	4200·3	0·5	22781	(4 : 11)

The figures in the third column are very nearly equal, and apparently there is no indication of a systematic difference in the figures corresponding to the lines denoted by P_1 and P_2.

The corresponding figures for the first lines in the ordinary spectrum of hydrogen (Ames, *Phil. Mag.*, xxx., p. 48, 1890) are:—

$\lambda \cdot 10^8$	$\lambda\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\cdot 10^{10}$	
6563·04	91153·3	(2 : 3)
4861·49	91152·9	(2 : 4)
4340·66	91153·9	(2 : 5)
4101·85	91152·2	(2 : 6)
3970·25	91153·7	(2 : 7)

According to the theory in question we have

$$K=\lambda\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)=\frac{ch^3(M+m)}{2\pi^2E^2e^2Mm},$$

where c is the velocity of light, h Planck's constant, e and m the charge and mass of an electron, and E and M the charge and mass of the central positive nucleus in the atom. This formula is deduced exactly as that given in the *Phil. Mag.*, where, however, in order to obtain a first approximation the mass of the electron is neglected in comparison with that of the nucleus.

The above tables give for hydrogen and for helium respectively

$$K_H=91153.10^{-10}, \quad K_{He}=22779.10^{-10}.$$

The ratio between these values is:—

$$\frac{K_H}{K_{He}}=4·0016.$$

From the theoretical formula we get for hydrogen, putting $E=e$ and $M=1835m$, and using recent determinations of h, e, and m:—

$$K=92.10^{-7}.$$

The agreement with the experimental value is within the uncertainty due to experimental errors in h, c, and m.

The theoretical value for the ratio between K for hydrogen and for helium can be deduced with great accuracy, as it is independent of the absolute values of h, e, and m. Putting $E_{He}=2E_H$ and $M_H=4M_H$, we get from the formula:

$$\frac{K_H}{K_{He}}=4·00163$$

in exact agreement with the experimental value.

It may be remarked that according to the theory helium must be expected to emit a series of lines closely, but not exactly, coinciding with the lines of the ordinary hydrogen spectrum. These lines, hitherto not observed, correspond to $n_1=4$ and $n_2=6$, 8, 10 . . ., and have the wave-lengths 6560·3, 4859·5, 4338·9 . . . The lines are expected to appear together with the lines of the Sharp series observed by Fowler and to have intensities of the same order as the latter lines.

N. BOHR.

The University, Copenhagen, October 8.

I AM glad to have elicited this interesting communication from Dr. Bohr, and I readily admit that the more exact form of his equation given above is in close accordance with the observations of the lines in question. It will be seen that the equation now introduces a modified value for the Rydberg series "constant," 109675, in addition to its multiplication by 4 for the particular series under consideration. The constant 22779, which is deduced from the wave-lengths of the lines is the reciprocal of this modified number, and in the usual numerical form, for oscillation frequencies corrected to vacuum, the equation for the lines would be:—

$$n=(4\times 109{,}720)\left\{\frac{1}{3^2}-\frac{1}{m^2}\right\}$$

where m takes the values 4, 5, 6 . . . .

With this modification, the agreement with the observations is very close; in only two cases do the calculated values differ from those observed by amounts greater than the estimated limits of error, and I should not like to insist that such errors in the measurements are inadmissible. It may therefore be possible to unite the P_1 and P_2 series in a single equation, as Dr. Bohr's theory requires, but it should be noted that the combination demands the recognition of a type of series differing from those previously known. The result of this combination is to give what may be called a "half-step" series, such as would be obtained by combining ordinary first and second subordinate series, in the special case where the fractional parts of the terms $(m+\mu)$ in Rydberg's equations for the two series differed by exactly 0·5. Consideration of the relative intensities of the two sets of lines would in general prohibit this procedure, but this objection cannot be made in the case of the lines under discussion. It is possible that the magnesium spark lines, which I have recently described, form another series of the same kind, but I know of no others.

The corrected formula given by Dr. Bohr leads to the further important result that alternate members of the ζ Puppis series cannot be superposed on the Balmer hydrogen lines, as at first appeared, but should be slightly displaced with respect to them. Dr. Bohr, however, appears to have inadvertently interchanged the last two figures of the constant 22779 in working out the wave-lengths, and the lines should be expected, within very narrow limits, at 6560·37, 4859·53, 4338·86, 4100·22 . . . . This should provide a valuable test of the theory, as the lines near Hβ and Hγ, at least, should not be very difficult to detect, if present, in stars of the ζ Puppis type. The tables published by Lockyer and Pickering give no indications of lines in the positions calculated, but further examination of the photographs is highly desirable.

It should be noted in conclusion that Dr. Bohr's theory has not yet been shown to be capable of explaining the ordinary series of helium lines.

A. Fowler.

Imperial College, South Kensington, October 14.

Azolla in Norfolk.

A very interesting case of the rapid spread of an introduced species is afforded by *Azolla caroliniana*, a North American species. So far as the Norfolk Broads are concerned, this free-floating water-fern has hitherto been confined to a single ditch or "dyke" near Horning Ferry, on the river Bure. Here the plant flourished greatly, covering the entire surface, but owing to the isolation of the "dyke" was prevented from spreading. According to an inhabitant of the neighbouring village of Ranworth, the plant has been observed in this one spot for the past fifteen years. I have no evidence as to its original introduction. The disastrous floods of August, 1912, carried some of the plant into the Bure, and its increase during the past twelve months has been extraordinary. Distributed by the tide it is now abundant in several of the Broads, and is carried by the tide in large quantities along the Bure and its tributaries, the Thurne and the Ant. It has found the still waters of South Walsham and Ranworth Broads particularly suited to its needs. It is most partial to the reed swamps of *Typha angustifolia*, so characteristic of the borders of our fen-lakes, and with this protection it is seen in large crowded expanses. More and more of the marsh and fen "dykes" are being invaded. It seems probable that the spread of the species to the other rivers of the Norfolk system, the Yare and the Waveney, will be prevented by the brackish nature of the water below Acle Bridge. I understand that a hard winter would probably kill the plant off, but its abundant sporocarps would carry it over to the succeeding spring.

Undoubtedly ecologists will soon find it necessary to include *Azolla caroliniana* in the local open reed-swamp association as a subdominant. It is a highly ornamental plant, being pale green in spring, and exhibiting a hundred shades of brown and red in autumn.

It would be interesting to know the result of competition between Azolla and members of the Lemnaceæ, and I am at present carrying out experiments to test this point.

W. E. Palmer.

Great Yarmouth.

The Theory of Radiation.

I owe Prof. Nicholson an apology. His work is, of course, earlier than Dr. Bohr's, and is actually cited by the latter. The wording of my letter (Nature, October 9) implies the reverse.

S. B. McLaren.

University College, Reading, October 18.

RESEARCH IN AERODYNAMICS.

The fourth volume of researches from the Institut Aerodynamique de Koutchino covers the period 1910–1912, and deals mainly with determinations of the air-resistance of various bodies and with comparisons between the results obtained at Koutchino with those of observers elsewhere. A change in the standard temperature corresponding to the published results has been made since the publication of the three earlier volumes, the later determinations being referred to 15° C. instead of 0° C. to bring the results to a form more easily comparable with those of other experimental establishments.

An examination into the velocity standard of the institution has been carried out, the ultimate standard being the movement of the end of a whirling arm 16 ft. in radius. Three independent methods of estimating and correcting for the motion of the air in the room were used prior to the calibration of various anemometers on the whirling arm. The anemometers were divided into two groups, the first containing "vane instruments" and the second "pressure tubes."

It was found, when the anemometers were transferred to the wind-channel of the laboratory, that the vane type of anemometer gave somewhat lower results than the pressure tubes, and it was concluded that the latter were more trustworthy, since the centrifugal effect of whirling on the vane instruments might easily account for the differences found.

Using the new calibration of the air-channel resulting from these experiments, a series of determinations of the resistance of square plates normal to the air-current was made. The plates were 12·5, 25, and 50 millimetres side, and the values of the absolute coefficient of resistance are given as 0·58, 0·57, and 0·57 respectively. This is somewhat higher than the value hitherto accepted for plates of this size, and is more nearly equal to that previously given for plates of from 300 to 500 millimetres.

The same plates were also tested at inclinations to the air-current, the curves obtained for the normal force showing the well-known maximum at an inclination of about 35°.

Amongst the theoretical investigations is one entitled, "Méthode des variables de dimension zéro et son application en Aerodynamique." Reference is made to papers by Lord Rayleigh and others, but, curiously enough, there does not seem to be any indication throughout the paper that the author considers the method to have any further importance than that of convenience. Approached from another point of view, the method of no-dimensional variables arises directly from the principles of dynamical similarity, and is only one of the many uses of the laws governing similar motions. The importance of the physical meaning behind the mathematics appears to have been overlooked.

In the articles in this volume which deal with comparisons with other observatories it is concluded that the type of channel having enclosing walls is preferable to that of Eiffel, and that the channel used at Göttingen is more steady than that at Koutchino.

An attempt was made to repeat an experiment by Rateau on a discontinuity in the centre of pressure variations of an inclined plate. Between inclinations of 25° and 50° Rateau found a sudden change, whilst at Koutchino a continuous and well-defined curve was obtained over the same range, the curve linking up the ranges 0 to 25° and 50° to 90°. It is definitely stated that, although difficult to measure, the position of the centre of pressure for any inclination was always unique.

THREE BOOKS OF TRAVEL.[1]

(1) THE type of travel-narrative to which Sir Edward Thorpe's volume belongs is one of the commonest among books, but his manner of treating his subject is by no means common. The book bears upon it the stamp of a labour of love; to any reader who is attached to France, attracted by river navigation, or even generally was made in a steam yacht across the Channel, up the Seine to Paris, and back. It was made, it would appear, leisurely, and gave ample opportunity for the travellers to become well acquainted with the many beautiful places on the river, and for one of them, Miss Olive Branson, to prepare the admirable series of sketches with which the book is mainly illustrated, though some of the pictures are drawn from another source, and there is also a series of large-scale maps (1 : 125,000) of the rivers; these last will be found of real service to those who follow Sir Edward Thorpe on this fine river, as will the directions he gives in regard to its navigation and the official arrangements connected therewith.

Fig. 1.—Ba'albek, temple of Jupiter and Anti-Libanus. From "The Fringe of the East."

interested in the picturesque in scenery or architecture, it will make exquisitely pleasant reading; the personal element in the narrative, which introduces the companions who made the voyage, is never (as it often is in such books) given an exaggerated prominence, and withal there appears here and there indications of the scientific authority of the writer which suffice to give the book a further peculiar value. The journey with which the book deals

(2) Mr. Lukach, in the sub-title of his book, describes his journey as lying "through past and present provinces of Turkey." He has visited Mount Athos and other Levantine monasteries, and the islands of Rhodes and Cyprus, to each of which he devotes chapters. With the Holy Land, and especially Jerusalem, he deals at greater length, and his travels, which are dealt with in this volume, extended along the Syrian coast, inland along the north-and-south line from Jerusalem and the Dead Sea through Damascus, Hama and Aleppo, and as far as the Euphrates at Tell Ahmar, a village-name famous in association with Hittite and Assyrian remains. Much of the book consists merely of the

[1] (1) "The Seine from Havre to Paris." By Sir Edward Thorpe. Pp. xxi+493. (London: Macmillan and Co., Ltd., 1913.) Price 12s. 6d. net.
(2) "The Fringe of the East. A Journey through Past and Present Provinces of Turkey." By H. C. Lukach. Pp. xiii+273+plates. (London: Macmillan and Co., Ltd., 1913.) Price 12s. net.
(3) "A Naturalist in Cannibal Land." By A. S. Meek. Pp. xviii+238+plates. (London: T. Fisher Unwin, n.d.) Price 10s. 6d. net.

narrative of travel, but this is very well told, and many experiences which are likely to be of value to other wanderers in the somewhat intricate paths of the Nearer East are given prominence. Mr. Lukach has already written on Cyprus, and perhaps his chapter on that island in the present volume may be indicated as of special value, including as it does a brief historical review, but throughout the book, a medley as it must necessarily be, there is found a laudable tendency to avoid assuming for the reader a foreknowledge of the complex lines of Levantine history. For example, the note and "genealogical" table of the Eastern Churches on pp. 113, 114, will be welcome to those who have striven to comprehend the religious divisions of Eastern Christendom. The book is illustrated with many good photographs, mostly the author's own, and there is a small route-map.

(3) Mr. A. S. Meek has made extensive zoological collections for the Tring Museum, and in the present volume he narrates his adventures while doing so, and also, at the outset, gives some account of his preparation for a collector's career. We follow him, in his narrative, to New Guinea and to various island-groups in the region of that great island—the Trobriands, the Louisiades, the Solomons, &c. In New Guinea itself he has travelled widely, and not in British territory only; his two last chapters deal with expeditions into the heart of the Dutch area. Mr. Meek asserts that he can claim to be neither a man of science nor a descriptive writer; his colleagues at the museum, on the one hand, and his readers, on the other, may be willing to find undue modesty in the statement. Certainly he has provided the museum with much new material; an introduction to his book by the Hon. Walter Rothschild makes that clear, while so far as the literary claims of the work are concerned, the book has had the benefit of editorship at the hands of Mr. Frank Fox, who is well qualified for the task by his authoritative knowledge of Australasia. Mr. Meek's text unquestionably increases in interest as it progresses, and in addition to his personal adventures (from which, quietly narrated as they are, his own spirit of intrepidity emerges clearly enough) and his successes as a collector, a tribute is certainly due to his ability in dealing with the natives, on whose friendly aid—of the winning of which there is but one method and that the right one—he has often needed, and been able, to rely.

Fig. 2.—Scene, Trobriand Islands. From "A Naturalist in Cannibal Land."

NOTES.

The council of the Royal Meteorological Society has awarded the Symons gold medal to Mr. W. H. Dines, F.R.S., in recognition of the valuable work which he has done in connection with meteorological science. The medal will be presented at the annual meeting of the society on January 21, 1914.

The annual Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered on Friday, November 14, by Prof. W. J. Sollas, F.R.S., who will take as his subject "Paviland Cave." Prof. A. Keith, F.R.S., president of the institute, will occupy the chair.

THE death is announced, at sixty-two years of age, of Mr. H. Herbert Smith, vice-president of the Surveyors' Institution, a member of the council of the Royal Agricultural Society, and Gilbey lecturer on the history and the economics of agriculture, Cambridge University, 1900–03.

THE Paris *Temps* has just instituted an inquiry in scientific, industrial and medical circles as to directions in which developments of research are most desired. The object is to suggest the most useful discoveries which it is possible to make in the present state of scientific knowledge, and to indicate those awaited eagerly by workers in such various branches of science as electricity, mechanics, chemistry, physics, bacteriology, astronomy, &c. The result of the inquiry will show the point of view from which, at the close of this year, men of science are looking toward the future.

THE council of the Yorkshire Naturalists' Union has elected Mr. T. Sheppard, of Hull, the president for next year. The Yorkshire Naturalists' Union is one of the most successful associations of its kind in Great Britain, and has published many important monographs on the flora and fauna of the county, and also issues *The Naturalist*, which is one of the oldest scientific monthly magazines in the country. The union has a membership of nearly four thousand, and about forty important natural history societies are affiliated with it.

THE Harveian oration was delivered before the president and fellows of the Royal College of Physicians, on October 18, by Dr. J. Mitchell Bruce, who took for his subject "The Origin and Nature of Fever." The president of the college, Sir Thomas Barlow, presented the Baly gold medal to Dr. J. S. Haldane, F.R.S. The award of this medal is made every alternate year, on the recommendation of the president and council, to the person who shall be deemed to have most distinguished himself in the science of physiology, especially during the two years immediately preceding the award.

THE report of the council of the Cardiff Naturalists' Society adopted at the recent annual meeting shows that the membership is now 505, of whom twenty are life members. We notice that the council in May, 1913, adopted a suggestion made by Principal Griffiths that steps should be taken towards securing an early visit to Cardiff of the British Association. At the subsequent meeting of the City Council the suggestion was approved. An invitation has been forwarded to the council of the British Association, but the earliest practicable date now vacant is 1919. The programme for the present session deals with a diversity of topics, among which various aspects of animal and plant life are prominent.

THE council of the Institution of Civil Engineers has made the following awards for papers published in the Proceedings without discussion during the session 1912–13:—A Telford gold medal to Mr. James Mackenzie (Johannesburg); Telford premiums to Messrs. H. Hawgood (Los Angeles), J. K. Robertson (Bombay), G. S. Perry (Sydney, N.S.W.), and Gervaise Purcell (Los Angeles); and the Crampton prize to Mr. William Mason (Liverpool). The council has made the following awards in respect of students' papers read before provincial associations of students during the past session:—The James Forrest medal and a Miller prize to Mr. P. M. Chadwick (Birmingham); and Miller prizes to Messrs. A. J. S. Pippard (Bristol), T. P. Geen (Bristol), C. E. Holloway (Bristol), J. W. Burns (Glasgow), and B. A. E. Heilig (Birmingham).

THE Faraday Society has arranged for a general discussion on the passivity of metals to be held on Wednesday, November 12, in the rooms of the Chemical Society, Burlington House. The president-elect, Sir Robert Hadfield, F.R.S., will preside, and the following provisional programme has been arranged: Dr. G. Senter will open the discussion with a general introduction to the subject, and there will be papers by Dr. G. Grube (Dresden) on some anodic and kathodic retardation phenomena and their bearing upon the theory of passivity; Dr. D. Reichinstein (Zürich) on interpretation of recent experiments bearing on the problem of the passivity of metals; Dr. H. S. Allen on photo-electric activity of active and passive irons. Communications will also be read from Profs. G. Schmidt (Münster), Max LeBlanc (Dresden), E. Shoch (Texas), and Günther Schulze (Reichsanstalt, Charlottenburg).

A PARIS telegram announces the death, in a state of destitution, of M. Charles Tellier, the inventor of the cold storage system, at eighty-six years of age. Appreciative accounts of M. Tellier's work appear in *The Times* of October 21, and are here summarised. Born at Amiens, he devoted himself to scientific research, and his experiments found a practical outcome in 1876, when the first experimental cargo of frozen meat left France for Buenos Aires in *Le Frigorifique*, which had been built under his direction with cold storage compartments. His invention met at first with little appreciation, but at the present day cold storage has not only changed completely the set of the world's food trade, but has deeply affected the economic development of many important nations. Although *Le Frigorifique* was M. Tellier's finest achievement, he did not cease from the early 'sixties on to his death to apply all his forces to the advancement of that scientific knowledge on which practical refrigeration depends. His two books, written in very early days, "Le Froid appliqué à la Bière," and "La Conservation de la Viande par le Froid," laid the foundation of our knowledge of cold storage, and they have been followed by numerous other publications and papers, setting forth, as he made them, the results of his researches.

IT is announced in the October number of *The Museums Journal* that the next meeting of the Museums Association will be held at Swansea, the special object of meeting at that town being to offer advice with regard to the work of a newly established museum and art institute. In a later paragraph of the same issue reference is made to the question of the future of the museums established and furnished by the late Sir Jonathan Hutchinson at Haslemere, Selby, and Charles Street, London. Although the founder is believed to have spent something like 30,000*l*. on these institutions, no provision for their future maintainance is made in his will, the executors being empowered to dispose of them in such manner as they think best. At a meeting held at Haslemere last week it was announced that Mr. Jonathan Hutchinson, writing on behalf of the trustees of Sir Jonathan Hutchinson's estate, had stated that if it were found possible to raise the necessary endowment fund, the trustees were willing to hand over by deed the freehold site and the museum with all its contents to a suitable trust committee. It was also intimated that other members of the Hutchinson family were prepared to give substantial monetary help to any fund which it might be proposed to raise. The value of the site at Haslemere is estimated by the trustees at about 4000*l*.

The inaugural lecture for the newly founded lectureship in palæobotany at University College, University of London, was delivered on Friday, October 17, by Dr. Marie Stopes. Dr. Teall, F.R.S., the director of the Geological Survey, was in the chair. In the course of her lecture Dr. Stopes communicated the view that palæobotany is an independent science, though its main results are of particular service to botany, geology, or in practical mining. The first part of the lecture was devoted to a historical account of the subject, and a number of quotations were made from old books not generally known to palæobotanists. Historically the science has passed through three phases: the first when fossil plants were looked on as wanton ornaments, even at a time when animal fossils were recognised as being of organic origin; the second when plant impressions were drawn accurately and described, but without true understanding; the third when a scientific study of plant fossils revealed their importance in the conceptions of evolution and morphology of living plants, their value as "thermometers of extinct continents," and their importance to the stratigraphical geologist and coal miner. Dr. Teall said that he had been recently much impressed by the results of fossil botany, and expressed a hope that more students would give it careful attention. Prof. F. W. Oliver, F.R.S., in thanking Dr. Teall and the lecturer, said that he realised that the botanical side of palæobotany was not its only one; he agreed with the lecturer that palæobotany was an independent science, and he hoped before long to see a department of palæontology in the University.

On Wednesday, October 15, a conversazione was held at King's College, by the Royal Microscopical Society, when nearly five hundred fellows and their friends were received by the president, Prof. G. Sims Woodhead. The object was to bring together, so far as practicable, a series of exhibits which would demonstrate the many uses to which microscopes may be put at the present time, both in science and commerce, and to enable those interested or engaged in microscopic work to demonstrate the methods they employed and the results they had obtained. The centre tables in the Great Hall of the college were occupied by pond-life exhibits, and more than forty microscopes were arranged under the direction of D. J. Scourfield. These were the centre of interest to a large number of visitors throughout the evening, many of the living objects being beautifully shown. Among the exhibits which also engaged the attention of visitors, that by F. W. Watson Baker, a demonstration of the actual grinding of a lens for a microscope objective, holds a high place. The subjects of other interesting exhibits were:—A beautiful series of slides showing wild flowers under opaque illumination, Conrad Beck; preparation of rock sections, C. H. Caffyn; an experiment with the Abbe diffraction microscope to illustrate the effect of altering the phase of one of the spectra forming on image of a grating, J. E. Barnard; transparencies in colour, E. Cuzner and T. E. Freshwater; colour stereoscopic slides of water mites, H. Taverner; an eyepiece micrometer with diffraction grating—an ingenious method of avoiding the errors common to most micrometers, J. W. Gordon; foraminifera, E. Heron-Allen and A. Earland; apparatus for stereo-photomicrography and also for high-power binocular observation, J. W. Ogilvy; fluorescent objects illuminated by ultra-violet light, Max Poser; and exhibits to illustrate differential colour illumination, J. Rheinberg. Two lectures were delivered during the evening, one by Dr. E. J. Spitta on diatom structure and a demonstration of the microscopic structure of rocks, by C. H. Caffyn.

Some "Notes on the Struggle for Existence in Tropical Africa" are contributed to the current number of *Bedrock* by Mr. G. D. H. Carpenter, who spent nearly three years on the equatorial islands of Lake Victoria in studying the tsetse-fly on behalf of the Royal Society's Sleeping Sickness Commission. He emphasises the importance of studying mimicry under natural conditions rather than in the cabinet, and advances it as a strong argument in favour of the truth of the mimetic theory that the resemblance of one insect to another is explicable in exactly the same way as the resemblance of an insect to a dead leaf. On the theory of natural selection through minute variations, mimetic resemblances are simply a special case of coloration analogous to other special cases.

The October number of *The Fortnightly Review* contains an article by Henri Fabre, the veteran naturalist of Sérignan, on his relations with Charles Darwin. The article illustrates in an interesting way some of the leading characteristics of these two remarkable men—the combined fertility and caution in speculation shown by Darwin, with his determination to bring every hypothesis to the test of experiment; and the unrivalled powers of observation possessed by Fabre, his enthusiasm in the pursuit of his favourite study, and the charm of his literary style. Darwin, being interested in the homing instincts of the mason-bees, suggested to Fabre the making of experiments to determine, if possible, whether this instinct was at all dependent on a perception by the insects of the direction in which they were first carried away from their nests. A whole series of trials was carried out by Fabre, the essential feature in which was the enclosure of marked bees in a dark box, the carrying of the box with its inmates in a direction opposite to that from which the release was to take place, and the repeated rotation of the box at different points of the route, in order to ensure that the captive bees should lose their bearings during the journey. The experiment was repeated, with variations, many times over, the almost uniform result being that from 30 to 40 per cent. of the liberated bees found their way home without difficulty. This was contrary to the expectation of both inquirers, and Darwin next proposed to try the effect of placing the insects within an induction coil, "a curious notion," as Fabre observes. The experiment was performed, with amusing results. But in the end the experimenter was fain to confess that the homing instinct of his bees remained a mystery.

The Gypsy Lore Journal (vol. vi., Part 4) is largely devoted to an account by Mr. E. O. Winstedt of "The Gypsy Coppersmiths' Invasion of 1911–13." Owing to the reticence displayed by these people, the origin of the party which visited England is uncertain. Some claimed to be Caucasians, others Russians, and many seem to have forgotten the place whence they started. Galicia seems to be the probable home of many of the immigrants. They appear to be genuine gypsies, their skin colour being practically identical with that of the Russian peasantry. In their metal work there are remarkable coincidences with Indian art products. This monograph contains a very complete account of their religious beliefs, organisation, dress, manners, and customs. The excellent work being carried out, with very limited resources, by the Gypsy Lore Society, which has its headquarters at 21A Alfred Street, Liverpool, should invite support from all who are interested in this remarkable race and from students of anthropology.

RECENTLY the Prehistoric Society of East Anglia formed a committee to investigate the "Red Crag shell portrait" at present in the possession of Dr. Marie C. Stopes. The report of the committee has now appeared in the excellent Proceedings of that society (Part 3, vol. i.). The shell represents a typical Red Crag species, and bears the crude carving of a human face. The committee reported that "the weight of evidence was in favour of the Pliocene age of the human work on the shell . . . it was impossible to speak with absolute certainty on the point." One has only to glance at the other articles included in this volume to see how much and varied is the prehistoric research which is being carried out at present in East Anglia. Dr. Allen Sturge has applied Drayson's theory to explain the occurrence of periods of glaciation; a description is given by Mr. J. Reid Moir of worked flints from the mid-glacial gravel and chalky boulder clay of Suffolk; an account is written by Col. Underwood of Pleistocene bones and flint implements from a gravel pit at Dovercourt, Essex. The description of a Palæolithic site on Wretham Heath, near Thetford, by Dr. J. E. Marr, of Cambridge, is particularly interesting. Mr. W. G. Clarke contributes a paper on Norfolk implements of Palæolithic "cave" type. The Proceedings of the East Anglia Prehistoric Society contain matter which archæologists and anthropologists cannot afford to overlook.

A PARAGRAPH in NATURE of October 9 (p. 175) upon a pamphlet recently issued by the National Equine Defence League, referred to a Bill to prohibit the docking of horses, printed at the end of the pamphlet, as having become law. The honorary secretary of the league writes to say that the Bill was abandoned last session in order to be amended, and will again be introduced next session. A clear statement to this effect might with advantage have been printed upon the same page of the pamphlet to prevent a mistaken conclusion such as was arrived at by our contributor. The honorary secretary will be pleased to forward any information upon the subject to anyone applying to him at Beaconsfield Road, New Southgate, London, N.

IN No. 2014 of the Proceedings of the U.S. National Museum (vol. xlvi., pp. 93–102) Mr. C. W. Gidley gives a preliminary account of mammalian remains from a Pleistocene cave-deposit near Cumberland, Maryland. Lower jaws of a bear and a dog are described as new species—*Ursus vitabilis* and *Canis ambrusteri*. As the former differs from the American black bear (*U. americanus*) merely by the larger lower canines, it might well have been regarded as a race of that species. The latter is of the size of a wolf, but has the lower carnassial tooth approximating to that of a coyote or a jackal. In the legend to the figures on p. 100 and the first paragraph on the opposite page, no fewer than eight misprints are noticeable, one of which, namely *Hyscius*, for *Lyciscus*, is distinctly puzzling.

THE size of litters and the number of nipples in swine forms the subject of an interesting paper by Messrs. G. H. Parker and C. Bullard in the Proceedings of the American Academy of Arts and Sciences, vol. xlix., No. 7. The authors have prepared a record of 1000 litters of unborn pigs of various breeds, and by means of tables arranged in order of the number of pigs in the litter are shown the relative position of the pig in the uterus, its sex, and the number and arrangement of its nipples. Of the total number of pigs examined 3024 were males and 2946 females, and in the whole population it was found that the nipples ranged from 8–18, with a mean of 12·2 and a mode of 12. In the majority (3559) the arrangement of the nipples was regular in character. No obvious relation would appear to exist between the size of the litter and the number of nipples in the females; though there may be as few nipples as eight and as large litters as fifteen, disadvantageous combinations of large litters borne by females with few nipples cannot be of frequent occurrence. Commonly there are about twice as many nipples, twelve, as young, six.

In the course of an article, "The Transmutation of the Elements," in the October number of *Bedrock*, Dr. Norman Campbell deals with the apparent synthesis of neon out of helium and oxygen by Messrs. Collie and Patterson, which was described last February, as well as with Sir J. J. Thomson's observation that helium, hydrogen, and neon can be obtained from many solids by kathode-ray bombardment. Dr. Campbell takes the view that to apply the word "transmutation" to these processes is rather an unfortunate step, although it might be described as mere quibbling to say that the kathode rays do not produce transmutation when the results of transmutation can only be made evident by means of kathode rays. If gold could be "liberated" from lead by such bombardment, the amount so liberated would only be the amount accumulated by long ages of spontaneous disintegration, and would utterly fail to materialise the traditional idea of "transmutation."

Vols. ix. and x. of the Collected Researches of the National Physical Laboratory maintain the high standard of excellence we have come to look on as natural in the work which issues from that institution. The present volumes cover the twenty-three papers published in the scientific or technical Press or in the proceedings of learned societies during the year 1912. One of the most important of the papers dealing with engineering problems is that on the properties of welded joints in iron and steel. It is found that acetylene welded joints are not so good as hand or electrical welded, and that while hand welded are somewhat better than electrical for alternations of stress, they are not so uniform in the results they give. Another important contribution to engineering knowledge is made in the report on the properties of alloys of aluminium and zinc. An extended series of tests leads to the general conclusion that the alloy containing 20 per cent. of zinc is the most promising. In electrical engineering the valuable papers on the properties of insulating materials and the circumstances which affect them supply much trustworthy information in a field in which uncertainty has reigned for too long a period. Other important facts are brought out in papers on the visibility of faint lights like those of vessels at sea, on photographic lenses and shutters, on the electricity emitted by carbon at high temperatures, and, lastly, that on a determination of the ohm by alternating-current methods, which has led to a result slightly less than the value at present accepted.

Messrs. C. A. Parsons and Co., Ltd., have despatched from their Heaton Works at Newcastle-on-Tyne the largest turbo-generator yet completed. An illustrated account of this machine appears in *Engineering* for October 17. The machine has been built to the order of the Commonwealth Edison Company of Chicago, a Corporation owning probably the greatest collective power-station in the world, and has been designed for a continuous load, at 750 revolutions per minute, of 25,000 kw., at a power factor of 0·95, the periodicity being 25 complete cycles per second. The steam consumption guaranteed is notable, and marks an epoch in steam plant. With steam at 200 lb. per sq. in., superheated to an extent of 200° F., and an absolute pressure in the condenser equivalent to 1 in., the guaranteed steam consumption at 20,000 kw. is 11·25 lb. per kw. output from the alternator; at 25 per cent. over or under the normal load, 11·65 lb. per kw. output; and at half-load, 12·5 lb. per kw. output. The steam consumption guaranteed for this turbine set—the largest ever fitted to a single shaft—is equal to 8·1 lb. per shaft-horse-power per hour, a result not hitherto attained in marine practice. Were oil fuel used in the boiler furnaces of a marine plant having this steam consumption, the fuel used would amount to 0·6 lb. per shaft-horse-power per hour, a result nearly comparable, from the point of view of radius of action in warships, with that attained by internal-combustion engines.

The ninth half-yearly volume of the Journal of the Institute of Metals contains the presidential address of Prof. Huntington and some half-dozen papers of considerable scientific and technical interest, read at the spring meeting of the institute. These include a paper by Mr. Alexander Siemens on metal filament lamps, papers on corrosion by Mr. Arnold Philip and by Dr. G. H. Bailey, a paper on the microstructure of German silver, by Mr. O. F. Hudson, and papers on the heat treatment of alloys by Mr. G. H. Gulliver and by Messrs. H. S. and J. S. G. Primrose. The excellent photomicrographs which illustrate the presidential address and three of the papers are a noteworthy feature of the present volume.

Messrs. Newton and Co., 72 Wigmore Street, London, W., have issued new catalogues giving full particulars of the optical lanterns, kinematographs, and projection apparatus which they able to supply. The sectional catalogues now published separately by this firm will prove a great convenience, as it will be possible easily to keep each up to date. Among these catalogues those describing the new science lanterns and the arc lamps deserve special mention. These instruments are the result of many experiments, and deserve the careful attention of lecturers and science teachers.

The October issue of Mr. C. Baker's list of second-hand scientific instruments contains particulars of more than two thousand pieces of scientific apparatus. Each instrument is guaranteed to be in working order, and the majority are in new condition. Especial attention may be directed to section 1 of the catalogue devoted to microscopes and accessories, of which a fine collection is available for selection.

At the head of the review of "The British Parasitic Copepoda" in Nature of October 16 (p. 193) the price of the work was erroneously given as 15*s*. The secretary of the Ray Society writes to point out that this is the price of vol. i. only; and that the price of vol. ii. is 25*s*. The price of the complete work is, therefore, 40*s*. net.

OUR ASTRONOMICAL COLUMN.

COMET NEWS.—*Astronomische Nachrichten* (No. 4686) gives improved elements for comet 1913*b* (Metcalf), and also an ephemeris, including the current week, from which the following positions are taken :—

12h. M.T. Berlin.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Oct. 23	20 51 54	+15 7·8	
24	50 52	13 18·9	
25	49 57	11 36·2	9·1
26	49 9	9 59·7	
27	48 26	8 28·6	
28	47 50	7 2·9	
29	47 19	5 42·0	9·4
30	20 46 53	+4 25·8	

The comet is rapidly reducing its northern declination, and as its magnitude is also decreasing it will become an object only for larger apertures.

Westphal's comet is becoming an interesting object, and will for some time be in a good observing position. It is moving into the constellation of Vulpecula, and during the first week of November will pass into Cygnus and become involved in the Milky Way. A photograph taken on September 28 showed a broad tail 3·5° long, a round nucleus of 20 min. in diameter, and a distinct nucleus. It has been glimpsed with the naked eye, and is an easy object for binoculars. The following is an approximate ephemeris :—

	R.A. h. m.	Dec. ° ′
Oct. 24	20 48	+19 46
28	43	22 23
Nov. 1	39	24 50
5	20 36	+27 16

It is worthy of note to mention that both Westphal's and Metcalf's comets are in about the same region of the sky, being less than two degrees apart on October 22.

The following are three positions for comet 1913*c* (Neujmin), now a faint object, published in *Astronomische Nachrichten* (No. 4685) :—

	R.A. (true) h. m. s.	Dec. (true) ° ′
Oct. 22	23 34 0	+13 55·7
26	35 29	14 33·3
30	37 29	15 7·4

The same journal (No. 4686) publishes the information received by Banachiewicz to the effect that the brightness of Neujmin's comet appears to be fluctuating. Its magnitude is fainter than 11.

ORBITS OF EIGHTY-SEVEN ECLIPSING BINARIES.—Dr. Harlow Shapley contributes to *The Astrophysical Journal* for September (vol. xxxviii., No. 2) a summary of an important though laborious piece of work on the orbits of eighty-seven eclipsing binaries. In the present publication he restricts himself to a few of the general results, leaving the complete statistical discussion for a future Princetown University Observatory publication. Some of the conclusions here briefly summarised show that the better the observations of an eclipsing binary are, the more satisfactory is the theoretical representation of the light variations. Further irregularities in the shape of the light-curves disappear with increased photometric accuracy. The existence of darkening towards the limb of the stellar disc is clearly indicated, and actually demonstrated in a few cases. There is a positive indication that the fainter star is self-luminous, and no case arises where it is necessary to assume one component completely dark. In discussing the distribution of densities relative to spectra the first-type stars (spectra B and A) show a marked preference for an intermediate density. The second-type stars fall into two groups, one preceding and the other following in order of density the first-type stars. Dr. Shapley points out that these two groups are obviously identical with the two classes of second-type stars of very greatly different luminosity discussed by Hertzsprung and Russell, and the facts collected afford direct support of Russell's theory that the differences in brightness of the two groups are to be ascribed in the main to great differences in the mean density.

VARIATIONS IN THE EARTH'S MAGNETIC FIELD.—In a short article in *Science* (August 29, 1913) Prof. Francis E. Nipher states that a series of open-air observations has fully verified the conclusions he has published regarding local magnetic storms. It appears that clouds prevent the solar ionisation of the air in their shadows, just as does the earth. When the molecules of air are ionised they become little magnets, and arranging themselves along the lines of force add their effect to that of the earth's magnetic field. In the absence of the solar radiation, wind or falling rain destroys this arrangement. It is hence suggested that local, daily, and annual variations are due to local variation in the weather. In a previous article in *Science* (May 30) Prof. Nipher describes a model with which a somewhat similar magnetic storm can be produced experimentally. In the model iron filings take the place of the ionised molecules of air.

THE LIGHT CURVE OF *o* CETI.—In the *Memorie della Società degli Spettroscopisti Italiani*, September, 1913, Sig. G. B. Lacchini publishes the results of his observations of this variable made during the period July 12, 1912–March 11, 1913. He used a telescope of 6 cm. aperture, 80 cm. focal length, with powers of 20 and 40, the comparison stars employed being those of the variable star section of the B.A.A. The epoch of minimum found was December 10, 1912, a result differing by only one day from that found by Dr. E. Guerrieri (December 9, 1912). The star lost one magnitude per twenty-seven days, and gained one magnitude per eleven days, according to Sig. Lacchini, which figures compare with 29·6 days and nine days respectively as determined by Dr. Guerrieri. The actual faintest magnitude recorded was 9·09 on December 3, 1912.

THE FRAUENFELD MEETING OF THE SWISS SOCIETY FOR THE ADVANCEMENT OF SCIENCE.

THE ninety-sixth annual meeting of the Société Helvétique des Sciences Naturelles was held, as already announced, at Frauenfeld in September. The set discourses were largely attended, and were listened to with considerable interest. Prof. Grubemann, in his lecture on the most recent methods employed in petrography, referred especially to the evolution of rocks, and the bearing of metallography and the chemistry of colloids on his subject. Prof. Maillefer gave an account of his researches on the geotropism of plants, partly from an experimental and partly from a mathematical point of view. He claimed to have proved that gravity has an effect on the curvature of a plant which requires time to take effect, and may be expressed by saying that the curvature possesses a velocity proportional to the sine of the angle made by the plant with the vertical and an acceleration proportional to the time of exposure. The effect is, he said, felt by the plant from the outset, though the time measurements seem to depend on the instruments used in the observations. His results were in a subsequent communication partly corroborated by Dr. Tröndle, who, however, does not admit the presence of an acceleration.

We pass over the remaining lectures, interesting as they were, remarking only on those of Profs. Keller and Dutoit. Prof. Keller dwelt on the points of resemblance between life in the Caucasus and that of the lake-dwellers in Switzerland in prehistoric times. Prof. Dutoit gave a brilliant exposition of the assimilation which is going on of the methods of analytical chemistry to those of physical chemistry and biology. The new processes employed which are, in point of fact, due in great measure to Prof. Dutoit himself, and have already rendered considerable services both to manufactures and science—are indirect, and have the advantage of great precision and extreme rapidity.

Turning to the separate sections, we commence with botany. Prof. Chodat, whose unique collection of cultures of algæ now numbers more than half a hundred, spoke of the bearing of his experiments on the systematic classification of these plants. Dr. Baumann, who has been studying the vegetation of the Lake of Constance, described how the small shells of gasteropods in these regions become coated with tufa, deposited by the algæ In this interesting way immense sandbanks of coarse sand, called after the little snails whose débris form it, "Schneckerlisand," are deposited in the lake. Prof. Ernst discussed parthenogenesis and apogamy among the Angiospermæ, and showed that, contrary to Treub and Lotsy, the embryo of the Balanophoraceæ is formed normally. The asexual reproduction of garlic from the point of view of heredity and natural selection was treated by Dr. Vogler. Prof. Edouard Fischer, who has been engaged in experiments on corn-rust, showed the connection between the appearance of this plague and the position of the leaf attacked with respect to the horizontal. Mr. Jaccard discussed the influence of a mechanical force on the production and constitution of wood and woody plants.

The section of geology occupied itself with the fossils, the stratification, and the relief of Switzerland. Prof. Albrecht Heine communicated his latest observations of glacial deposits as corroborating his somewhat controverted explanation of the formation of alpine lakes by a subsidence of the earth's crust in these regions during the diluvial epoch. Dr. F. Mühlberg showed by an interesting collection of lantern-slides the fallacious nature of the interpretation of the formation of part of the Jura given by the Bonn school. Prof. H. Schardt spoke on a subject which belongs properly to the borderland of geology, the typical phenomena of injection. He pointed out how, during the gradual cooling of a mass of magma, sudden pressures of a tectonic nature must sometimes occur, squeezing the molten material into the interstices of the neighbouring rocks and causing the phenomena in question.

In the chemical section the school of Geneva was strongly represented. Dr. Reverdin's determination of the constitution of certain anisidines, in particular of the two still doubtful trinitro-*p*-anisidines, is of a more advancedly technical character than Prof. A. Pictet's interesting discovery by the process of distillation *in vacuo* of a new kind of tar smelling of petroleum, and Messrs. Briner and Kühne's reinvestigation of the still obscure mechanism of the chamber process for the production of sulphuric acid. The opinion arrived at by these latter investigators is that SO_4H_2 is obtained by direct oxydisation of SO_2 into SO_3, the nitrous anhydride serving only as a catalytic. Of quite a different nature were Dr. Piccard of Munich's account of his experiments on certain dyes, and Dr. W. Baragiola's report on the physical, chemical, and physico-chemical experiments which have been made on wine and grape-juice.

In the physical section there were several communications deserving of mention; we content ourselves with signalising that of Prof. Perrier and H. Kamerlingh Onnes on the magnetisation of mixtures of liquid oxygen and nitrogen. These mixtures are found simpler to deal with than pure oxygen, the specific magnetisation coefficient of which had been already shown to differ materially from what would be expected by the law of Curie-Langevin. Experiments made at a temperature between $-195°$ and $-210°$ show that the deviation from the law in question depends on the mutual approach of the molecules caused by the fall of temperature.

In the mathematical section Prof. Fueter gave some instructive examples of algebraic equations possessing a prescribed group; Prof. Crelier read a paper, conceived in the order of ideas of Sturm, on correspondences in synthetic geometry, with special reference to the curve of the third order and third class; while Dr. Speiser and Prof. Bieberbach dealt with factorisation of algebraic forms and conformal representation respectively. Dr. Mirimanoff communicated a new and elegant proof of the theorem of Cantor-Bendixon, which, as he pointed out, falls into the same category as the first proof of that theorem without Cantor's transfinite numbers, that given by W. H. Young in "Sets of Intervals on the Straight Line" (Proc. L.M.S., 1, xxxv., pp. 245–268). Prof. W. H. Young gave a paper on "The Integral of Stieltjes and its Generalisation," showing how the theory of the integration of any function with respect to a function of bounded variation could be built up by the method of monotone sequences alone, and giving examples of new theorems, into the enunciation of which the new concept does not enter, and which he had obtained by means of its use.

Communications were also made to the sections for zoology, and for geophysics, cosmical physics, and meteorology, among them one by Dr. P. Mercanton, who added some details to Dr. de Quervain's account of the Swiss expedition across Greenland last year and the meteorology of that country. The rate of motion of the Greenland glaciers, which are mostly riddled with crevasses, was found, he said, to vary from one to two metres a day. At the base the grains of dust were not very large, the mean size not exceeding that of those in the alpine glaciers. Observations on some of the ancient glacial terraces showed that part of the dust was of cosmic origin.

PLANKTON DISTRIBUTION.[1]

In the University of California Publications in Zoology (vol. ix., No. 6), Mr. C. O. Esterly discusses the vertical distribution of certain Copepoda as shown by a large number of hauls made in the region of San Diego, between the years 1905 and 1911. Dividing the twenty-four hours into a "day" period from 6 a.m. to 6 p.m., and a "night" period of the remainder, the author finds in the results obtained a distinct night migration towards the surface, with a corresponding downward movement during the day. For nine out of ten species specially considered the time of this maximum occurrence at the surface is found to vary between 6–8 p.m. and 10–12 p.m., *Calanus finmarchicus* attaining its maximum in the latter period. The depth shown for the day plurimum is more obscure, ranging between 50 and 200 fathoms.

[1] "The Occurrence and Vertical Distribution of the Copepoda of the San Diego Region, with particular Reference to Nineteen Species." By Calvin O. Esterly. (Berkeley: University of California Press.)

The paper contains a large collection of data especially important as all relating to the same area and extending over a long period, but a marked want of care is shown both in the handling of the records and in the conclusions drawn from them. Numerous errors left uncorrected in the tables are very confusing though not, it would seem, seriously affecting the main results. Greater importance attaches to conclusions formed often quite out of proportion to the evidence available. As regards the question of nocturnal migration to the surface, while the records show the strongest evidence of a surface maximum during the night hours, they are far too incomplete to be relied on as indicating any definite period of optimum conditions. The maximum obtained for *Calanus finmarchicus*, for example, between 10 and 12 p.m., rests on the slender evidence of a single haul of 2·8 hours in duration, in which between three and four thousand specimens occurred. If this were indeed an optimum period, a higher average than fifty-eight specimens per hour might be expected between midnight and 2 a.m. The occurrence of a species in exceptionally large numbers suggests the presence of exceptional conditions, it may be, a combination of several factors at the time, to account for it. In estimating averages such a haul may, if unsupported by other evidence, give results that are quite misleading, and where it is used, as in the present case, for time-frequency alone, it is unsafe to place narrow limits to the period in which it happens to fall. In the two-hour period preceding this, viz. 8–10 p.m., an average of 973 specimens per hour is obtained from eight hauls made during that time. Had no other data been available than the four hauls covering this period in Table 2, the average given would be no more than nineteen specimens per hour in place of the 973. The example serves to emphasise the need of repeated observations before any safe estimate of such averages can be formed, or any deductions made from the latter.

The same remarks are applicable to the averages for Eucalanus and Metridia especially. For the former three maxima are shown, for the afternoon, evening, and morning severally, and the suggestion is even put forward that these are probably of normal occurrence, and should be considered so. The maximum for Metridia, placed at 10–12 p.m., rests, like that of Calanus, on the unsafe basis of a single haul of 31,900 specimens, the same haul as that from which the maximum for Calanus was obtained. The second highest aggregate for this species, namely 3401 specimens, was obtained from three hauls made between midnight and 2 a.m., and is apparently likewise dependant almost entirely on one haul of 3200 specimens, leaving an average of 100 specimens for the other two. In the case of *Labidocera trispinosa* the disproportion is greater still. Here the maximum, falling between 6 and 8 p.m., shows an aggregate of 2630 specimens obtained during this period in five successful hauls out of thirty, one haul containing 2425. The second highest aggregate, falling between 4 and 6 a.m., with a total of 527 specimens obtained in seven hauls, includes one haul with 500 specimens.

It cannot be lost sight of that all of these higher figures occur between the late evening and early morning hours, and, as a matter of general observation, the night preponderance of Copepod plankton near the surface will not perhaps be questioned by many. But data such as these are manifestly too incomplete alone to bear any interpretation more restricted than this, and though regarded by the author as implying different optimum periods characterising the different species, seem rather to express collectively particular instances of more or less abundant occurrence, in which any one or other of the species considered might equally well have been encountered on another occasion. It is indeed difficult to understand how, reasoning on such frail evidence, the discussion is carried even to the point of recognising in these different maxima obtained hidden characters distinguishing the species which are supplementary to those of structural features, such as to indicate, it may be, with more extended knowledge the apparent rather than real nature of the latter.

In estimating the hourly averages for the surface hauls the time occupied is made to include, rightly it would seem, that of hauls from which a species was absent. Thus is obtained the average number of animals occurring per hour of hauling. In calculating the depths for the day plurima, as shown by the self-closing nets, the averages based on the number of animals per fathom passed through are not treated in the same manner, but merely express the depth of the layer of water as a fixed quantity regardless of the number of hauls made through it. Thus, for *C. finmarchicus*, the region of the day maximum shown between 50 and 77 fathoms is estimated by all the animals in all the hauls (seventeen) made through that section of water being treated as though occurring in one haul through 25 fathoms. The average found at this depth, namely, 15·7 per fathom, therefore denotes no more than the distribution over the layer concerned of an aggregate of animals captured between 50 and 75 fathoms, and cannot be considered as on the same plane with that found between 75 and 100 fathoms, where six hauls made through a similar depth of water show an average of 5·7 animals per fathom. If the repetition of hauls through a given column of water be not given a true value, the averages are incomparable with one another, and important evidence afforded will be lost in the results obtained.

Considerable distortion of the latter averages is liable to have arisen through no allowance having been made for differences in the size of the nets used, amounting to as much as one-half the mouth opening. The impression that such allowances are of no practical value, if intended to be understood literally, might have been removed had the author tested the different-sized nets against one another.

L. R. C.

THE BRITISH ASSOCIATION AT BIRMINGHAM.

SECTION K.

BOTANY.

OPENING ADDRESS BY MISS ETHEL SARGANT, PRESIDENT OF THE SECTION.

WE were welcomed to Birmingham last night, and now—made free of the city—we assemble this morning to justify our position as its guests. But before entering on the work of the section, your president is authorised, and even required by custom, to glance at the events of the past year in the botanical world.

My predecessor in this chair had a great loss to record in the death of Sir Joseph Hooker, the *doyen* of British botanists, and a familiar figure at so many meetings of this Association, where we were proud to feel that he belonged to our section. This year we have no peculiar grief, but we join with the whole Association in lamenting the death of Lord Avebury. We have some right to offer a special tribute to his memory, since several of his published works were on botanical subjects. His book on the "Fertilisation of Flowers" in the "Nature Series" opened a new world to many non-botanical readers, and there are probably others here besides myself who have reason to be grateful to him for that charming introduction to field botany, and for the companion volume on "Flowers, Fruits, and Leaves." The great mass of first-hand information on the external characters of seedlings, contained in two massive volumes under the modest title of "A Contribution to our Knowledge of Seedlings," was collected under his direction and put together by himself. It is not only a book of reference to students of vegetable embryology, but no doubt played its part in reviving interest in that important subject. The work which he published was, however, the least part of Lord Avebury's contribution to natural history. He represented a small but most distinguished class of naturalists, amateurs in the best sense of the word, since they work for pure love of the subject. Whether they happen to be men of affairs in great positions, like Lord Avebury, or artisans devoting their Saturday afternoons to original research in natural history, they are the salt of the subject, preserving it from the worst effects of a purely professional and academic standard.

There is one more event of the past year to be mentioned before entering on the professional portion of this address. Section K has made a great innovation in choosing a woman for its president this year, and I will not refrain from thanking you in the name of my sex because I happen to be the woman chosen. And though I must and do feel very keenly the honour you have done me as a botanist in electing me to this position, yet that feeling is less prominent than gratitude for the generosity shown to all women in that choice. Speaking in their name, I may venture to say that the highest form of generosity is that which dares to do an act of justice in the face of custom and prejudice.

The main subject of my address this morning is the development of botanical embryology since 1870.

Botanists, as well as zoologists, have used the term embryology in two senses. Balfour's remarks apply to both sciences:—

"Strictly interpreted according to the meaning of the word, it ought to deal with the growth and structure of organisms during their development within the egg-membranes, before they are capable of leading an independent existence. Modern investigators have, however, shown that such a limitation of science would have a purely artificial character, and the term embryology is now employed to cover the anatomy and physiology of the organism during the whole period included between its first coming into being and its attainment of the adult state."

The older botanists used the term in the narrower sense. They included the study of the embryo-sac and the structures contained in it before the formation of the unfertilised egg-cell, as well as the fertilisation of the latter and its subsequent divisions. But they did not proceed beyond the resting-stage of the embryo within the ripe seed. Here, as in zoology, this division is arbitrary and inconvenient. Accordingly, in the following remarks on the embryology of Angiosperms, I include every stage in the development of the plant, from the first division of the fertilised egg-cell to maturity.

Systematists, from Cæsalpino onwards, have paid much attention to the structure of the seed, and their observations are the earliest we possess on botanical embryology. They were, indeed, forced to study the embryo because its characters are often of systematic importance. The number of cotyledons, for instance, is the most constant character which separates the two great classes of Angiosperms. Again, the endosperm is not part of the embryo, but its presence or absence in the ripe seed—so important systematically—determines the functions of the cotyledons after germination, and thus influences their structure profoundly. In this way botanists became familiar with the structure of the embryo in the ripe seed before they had traced its origin from the fertilised egg-cell or followed its development after germination.

The early history of the embryo was a sealed book to observers without the help of the compound microscope. Accordingly we find that work on the external morphology of seedlings preceded that on the formation of an embryo. For the description of seedlings we must go back to the middle of last century. The greatest name in this school is that of Thilo Irmisch (1815–79). His work, like that of earlier observers in the same field, was neglected by the succeeding generation owing to the rapid development of microscopic botany. For a time the study of anatomy eclipsed that of external morphology.

The earliest observers to study the embryo-sac of Angiosperms with the help of the compound microscope were naturally attracted by the history of the ovum and the process of fertilisation. Little progress was made in this direction, however, owing to the imperfect technique of the day. The divisions of the fertilised egg-cell are more easily followed, as Hanstein showed in 1870. His classical paper is the foundation of botanical embryology in the narrower sense—that is, of the study of the embryo from origin to germination.

This period in the plant's history would seem, indeed, very well defined. It begins with the first division of the fertilised egg-cell—undoubtedly a natural epoch, for a new generation dates from it. It ends with the formation of the ripe seed, which is a true physiological epoch, since it corresponds with a complete change in the conditions of life. We have seen also that the morphologists who have dealt with the immature plant have fallen naturally into two groups, one ending and the other beginning their work at this very point.

Experience, however, has shown here, as in zoology, that embryologists lose more than they gain by this division of their subject. It is, indeed, neither so simple nor so natural as it appears at first sight.

It is not simple because the embryo is not always completely dormant during the interval between the formation of the ripe seed and the first steps in germination. On the contrary, in a large proportion of Monocotyledons, and in a smaller but still considerable proportion of Dicotyledons, the embryo is an almost undifferentiated mass of meristem when the seed first ripens. It becomes differentiated internally and externally by degrees during the long interval before germination. This is sometimes called the maturation of the seed, and it is quite distinct from its ripening. Maturation is a process characteristic of the seeds of geophilous plants, which commonly lie in the ground for a year at least before germination.

In such cases the period of rest occurs immediately after the seed is ripe, and while the embryo is still undifferentiated. But the embryo is not comparable morphologically to that in the seed of an annual, for example, which may have ripened at the same time. The embryo of an annual has root, stem, and leaves, besides its cotyledons, and is ready to germinate immediately on the return of spring.

The morphologist, then, must continue the study of his geophilous embryo throughout the period of maturation if he is to compare it with that of the annual. Even then he will find it less advanced than the annual embryo, though both be examined as they break out of the seed. For the geophyte may perhaps be four or five years before it flowers, while the annual has to complete its whole life-cycle in a single season.

Nor is the division of the subject into two parts, the first ending with the embryo in the ripe seed, a natural one, even if the time of maturation be included in that first period. The structure of the embryo cannot be completely grasped by reference to its past only. The observer must expect adaptive characters of three kinds: first, those imposed upon the embryo in the past by its development within the embryo-sac while it is still parasitic on the parent plant; secondly, certain adaptations to the process of germination itself; and, finally, characters which will be useful after germination. Before the utility of the characters included in this third class can be fully understood, the development of the seedling must be followed for some time. In short, the structure of the embryo is dependent on its future, as well as on its past; and a division of the subject which excludes that future is, as Balfour says, purely artificial. Thus the work done of late years on the anatomy of the seedling has not only completed Irmisch's work on its external morphology, but has also thrown light on the problems of early embryology attacked by Hanstein and his immediate followers.

These problems are of two kinds, relating to the internal anatomy or the external morphology of the embryo. Hanstein himself was chiefly interested in the former. It is curious to realise when reading his paper that up to the date of its publication botanists were prepared to find an apical cell in the embryo of Angiosperms. They acknowledged, indeed, that no such cell existed in the growing-points of the mature plant.[1] There each new portion of tissue was formed by the activity of a group of similar and equivalent cells. But it still seemed possible that the embryo might possess an apical cell in the earlier stages of its growth—a reminiscence of its Cryptogamic ancestors. Hanstein's work disposed once for all of this possibility. It was conclusive even against the great authority of Hofmeister, who had described an apical cell in the embryo of orchids.

One general result of the work on the embryo since Hanstein's time has been to discredit phylogenetic theories based on its early history. Indeed, it was scarcely to be expected that a small mass of meristem, developing within a confined space and feeding parasitically on the tissues of the mother-plant, should preserve ancestral features, and one is surprised to find a morphologist with the experience and the wide grasp of Hanstein attaching so much importance to the succession of divisions within such a body. The conscientious student finds it a laborious task to follow the work done in plant embryology during the period which succeeded the publication of Hanstein's great paper. No wonder that when the end is seen to discredit rather than crown much of that work, when he realises how little has been gained as a result of so much patient toil, he is apt to renounce the whole subject in disgust. Yet in science we dare not rule out the unexpected, perhaps even less in morphology than elsewhere. Hanstein and his successors did good service when they described the growth of the pro-embryo from the fertilised egg-cell, its division into suspensor and embryo, the general development of both, and the appearance of external and internal differentiation in the embryo before germination.

Some of Hanstein's general conclusions as to internal anatomy have become the common property of text-books; for instance, the early differentiation of dermatogen in the embryo, and its subsequent development into the epidermal system. He was less successful in demonstrating the initial independence of plerome and periblem and their relation to the vascular cylinder of the mature stem.

[1] Korschelt in 1884 revived the hypothesis that the growing points of some Angiosperms at any rate increased by means of an apical cell. He worked chiefly on aquatic plants. His views have not been accepted.

The early differentiation of plerome and periblem from the internal tissues of the embryonic axis, and their continued formation at the growing points of stem and root respectively, are processes which demand the most careful investigation, on account of their bearing on the stelar hypothesis.

Dr. Schoute's work on the exact relationship of plerome and periblem at the growing-point to the central cylinder and cortex as differentiated in the older regions of the same axes, whether stem or root, is very important. He accepts Prof. Van Tieghem's definition of the stele as the solid cylinder of root or stem enclosed within the endodermis. The endodermis itself, of course, is considered as belonging to the cortex, because in the root its cells are opposite the radial files of the inner cortex, and, indeed, form the inmost rank of those files This is assumed to indicate a common origin by repeated tangential division. The cells of the pericycle—the outermost layer of the stele—alternate with those of the endodermis. As a rule, there is no corresponding radial arrangement in the cortical tissue of the stem, but where such exists—as in the stem of Hippuris—the endodermis is again included in it and terminates it.

Using the microtome as an instrument of precision, Dr. Schoute in 1903 published the most careful observations on the growing-points of roots. His aim was to determine whether the limit between plerome and periblem (Hanstein) corresponded with that between stele and cortex (Van Tieghem). For this purpose Dr. Schoute was, of course, obliged to choose roots in which the plerome is clearly distinguished from the periblem at the growing-point. In the end he obtained precise results in three species: *Hyacinthus orientalis*, *Helianthus annuus*, and *Linum usitatissimum*. In each of these the periblem passed into the cortex, its inner layer becoming the endodermis, and the plerome gave rise to the stele only.

Owing to difficulties of observation, arising chiefly from the insertion of leaves close up to the growing-point and displacements in the original stem-structure consequent on this habit, Dr. Schoute was not equally successful in his work on stems. *Hippuris vulgaris* was the only species to give definite results. In this species he found that the plerome gave rise not only to the stele, but also to the endodermis, and to the two or three layers of cortex immediately beyond it. If these results are well founded the limit between plerome and periblem does not correspond with that between stele and cortex in the stem of Hippuris. Moreover, doubt is thrown on the assumption made by all previous observers that rows of cortical cells arranged in radial files must be of common origin.

Observations on a single species, however well attested, form a slender basis for conclusions regarding stems in general. Nor have Dr. Schoute's observations escaped criticism. Dr. Kniep has since examined the growing-point of Hippuris, and believes that he can identify plerome with central cylinder, and periblem with cortex, even in this test case. However this may be, no one denies the obscurity of stem anatomy in this respect compared to that of the root, nor the cause of that obscurity. The continuity of the stem stele is perpetually interrupted by the insertion of the leaf-traces, just as the symmetry of the stem growing-point is destroyed by the formation of leaf rudiments close up to its apex.

The stelar hypothesis is essentially an assertion of the real homology between the vascular systems of stem and root throughout all vascular plants. This was pointed out to me more than twenty years ago by Dr. D. H. Scott, and it has been the sheet anchor to which I have since clung through much stress of morphological weather. No difficulty arises so long as we are dealing with roots only, or with the stems of those vascular Cryptogams in which the vascular system is a closed cylinder, without gaps at the insertion of the leaf-traces. In such stems the vascular cylinder is as well-defined as in all roots, and can be described in the same terms. But the case is quite different in the stems of Phanerogams, where to all appearance the primary vascular cylinder is a system built up of leaf-traces, embedded in a parenchymatous matrix. And the early anatomists were faced at once by this problem in its crudest form. Beginning with the anatomy of Phanerogams, they first became acquainted with the primary structure of the Dicotyledonous stem. That of the root was not clearly understood until many years later; perhaps because anatomists attempted to interpret it by reference to the skeleton of the stem, and in the same terms. But there is nothing in the vascular anatomy of the root to correspond with the leaf-trace, and the leaf-trace is the vascular unit of stem-structure in all Phanerogams. Here, as elsewhere, confusion of nomenclature went hand in hand with confusion of thought, and it is difficult to say which was cause and which effect.

Even when the facts of root-structure were accurately known, the conception of the leaf-trace bundle as the structural unit continued to be a stumbling-block. In 1877 De Bary published his monumental work on plant anatomy, and though it still keeps its place as the great book of reference on that subject, his descriptions of root anatomy appear to the modern botanist to be written in a dead language. When he calls the vascular axis of the root a "radial bundle" it is quite clear that he regards this as a purely formal term, not implying any true homology between the leaf-trace bundle of the stem and the axial core of the root. He does not, indeed, consider a bundle as a unit: he defines it as a compound structure "formed of tracheids and sieve-tubes definitely grouped."[2] But the word "bundle" was already impressed with another superscription. However defined originally, it had connoted the unit of stem-structure to a generation of botanists. With that connotation, De Bary's use of the term is in hopeless conflict. Moreover, the conception underlying that use was already out of date in 1877. Modern anatomy dates from 1871, when Prof. Van Tieghem published the first of his great series of memoirs on the subject. In these the axial core of the root was treated as equivalent to the whole system of leaf-trace bundles in the stem, though the word "stele" was not yet invented. This conception gained ground from the first; it was popularised by the happy choice of a name in 1886. From that date the stelar hypothesis has replaced all other schemes of vascular anatomy. The advance then made on all previous generalisations has been shown by the new impulse given to research, and the comparative simplicity introduced into text-book anatomy.

We cannot claim equal simplicity, I fear, for the technical language of research in this subject, and this alone should inspire caution, for obscurity of language rarely persists where there is no corresponding obscurity of thought.

No one now doubts that the central cylinder of the root in Phanerogams is far more closely comparable to the leaf-trace cylinder of the stem than to any one of the traces within it. Yet when the comparison becomes detailed, difficulties are constantly arising. Where, for example, there is a medulla in the root it certainly forms part of the stele, which is a solid cylinder sharply defined by the specialised endodermis surrounding it. But the leaf-traces in the young stem surround a massive cylinder of parenchyma, precisely resembling the parenchyma of the cortex, with which it is in apparent connection through the gaps between the leaf-traces. Even the secondary formations do not completely divide one system from the other. When a specialised endodermis is present it is not so clearly defined as in the root: in many cases it is not present—in other words, there is no cell-layer outside the leaf-trace cylinder which is differentiated in any way from the surrounding tissues. In a few instances—most baffling of all—an endodermis surrounds each leaf-trace.

The stele in the stem of Phanerogams is not of necessity a morphological fiction, because in many stems its precise limits cannot be determined. If, indeed, the word be used as a descriptive term, its value is seriously impaired by every instance in which it fails to describe stem-structure with precision. But morphology is not merely descriptive. If we suppose that the stem-stele in remote ancestors of the Phanerogams was as well defined as that of the root and clearly comparable to it, we may attach a real morphological meaning to the term when applied to modern Phanerogams, provided we can show cause to believe that what we call the stele in their stems represents the ancestral stele. Its tissues will then have a history distinct from those of the cortex, though not clearly separated from them. The burden of proof, however, certainly lies with those who assert that an apparently continuous and uniform tissue can be separated into two parts of distinct origin.

The evidence advanced is of two kinds—one founded on the comparative anatomy of stems, and the other on the history of the tissues in the individual plant. Dr. Schoute has argued the case with great skill from the first point of view in his "Stelärtheorie." Depending to a large extent on his own researches, he has collected a great body of evidence to show that in the stems of Angiosperms a specialised layer is commonly distinguished from adjacent tissues either by the peculiar thickening characteristic of the endodermis in the root, or by the presence of starch in its cells. He shows that such a sheath surrounds the vascular cylinder in a very large proportion of the Dicotyledons examined, and in a majority of the Monocotyledons. Among Gymnosperms it occurs but rarely. Observing that the Angiosperms in which this bundle-sheath is obscure or wanting are commonly closely related to species in which it is perfectly well defined, Dr. Schoute concludes that its absence in such cases must be attributed to reduction.

Allowing that such a layer is as general among Angiosperms as Dr. Schoute believes, grave doubts may still exist as to its homology with the endodermis of the root. The latter is defined not only by its thickened walls, but also by the position of its cells. They form the inmost rank of the series of radial files which distinguish the inner cortex, and the morphological endodermis—the phlæoterma, as Strasburger calls it—can usually be distinguished by this purely morphological character, even when its walls are unthickened. In the stem, however, the cells of the inner cortex are not radially arranged, except in rare cases, such as Hippuris. Thus there is no morphological criterion to distinguish the phlæoterma, or inmost cortical layer of the stem, from adjacent tissues. The bundle-sheaths distinguished by their

[2] "Comparative Anatomy of Phanerogams and Ferns." 1st Eng. ed., 1884, p. 400.

thickened walls or by the presence of starch in their cells are physiologically similar; they play a definite part in the economy of the stem, but the presence of either character must depend mainly on the demands of the conducting or assimilating system, and need not imply the morphological identity of such layers with each other, or with the layer performing a similar function in the root.

Turning now to the second class of evidence—that drawn from the history of the tissues in the individual plant—we have already seen that the differentiation of plerome from periblem is far less definite at the growing point of the stem than at the root. Doubts have even been thrown on the identity of plerome and periblem with stele and cortex respectively. But we have not yet followed the development of the tissues of the embryo into those of the seedling.

The normal seedling[3] of all Phanerogams consists at first of cotyledons, hypocotyl, and root, the plumular bud being still rudimentary. The primary root lies as a rule in a straight line with the primary stem, or hypocotyl. The hypocotyl is commonly the first part of the embryo to lengthen, and then its xylem is lignified a little earlier than that of the root or even that of the cotyledon. But when—as in many Monocotyledons—the base of the cotyledon lengthens first, lignification begins in that region and advances through the hypocotyl to the primary root.

The anatomy of the seedling at this epoch has lately been investigated by many independent observers. They constitute, indeed, the third school of embryology to which I have referred as completing the work of two earlier schools—namely, morphologists of the type of Irmisch, and students of early embryology like Hanstein and his school. But though the subject is limited to a short period in the history of the plant, and to one in which its vascular structure is comparatively simple, yet it has been attacked from different sides, and the attempt to give a concise account of the results attained is beset with difficulties. For the present, however, I propose to consider only their bearing on the stelar hypothesis.

Indeed, seedling anatomy becomes extremely important when the vascular system of the root is compared with that of the stem. For in the seedling we have a complete and simple vascular skeleton, which at one end belongs to the primary root of the plant, and at the other to its primary stem. There must be an intermediate region in which stem-structure passes into root-structure, and the method of transition should at least suggest, if it does not precisely determine, the relation in which they stand to each other. For this reason great value has been attached by anatomists to the transitional region of the main axis. It was not completely investigated, however, until the microtome was introduced into botanical practice, for the change of structure is often very abrupt, and cannot be studied in detail unless all possible sections are present in their proper order.

In this, as in other branches of modern anatomy, Prof. Van Tieghem was first in the field. In his memoir of 1872, "Sur les Canaux Secréteurs des Plantes," he described the course of the bundles of the hypocotyl of *Tagetes patula*, an example of the second type of transition given in his textbook (1886). The three types were, indeed, already identified in 1872, for the first and third are defined in a footnote appended to the description of Tagetes.

Tagetes patula was, of course, examined in 1872 with the aid of hand-sections only. Two traces enter the hypocotyl from either cotyledon, and form in the end a diarch root. The plane passing through its xylem poles is the median plane of the cotyledons. In the upper part of the hypocotyl this plane bisects the space which separates the two bundles entering each cotyledon. So far the description of Tagetes given in 1872 is identical with the generalised account of type 2 in the text-book (1886). But a detail of some importance is mentioned in the description of Tagetes which does not reappear in the definition of type 2. In each of the spaces just mentioned—called, for convenience, xylem spaces, because they lie above the xylem poles of the root—lies an isolated xylem element, the direct continuation of the most external element in one of the root poles, and this element comes to an abrupt end higher up.

Thus Prof. Van Tieghem has tacitly assumed that Tagetes is exceptional in this respect, and this view was also adopted by Prof. Gérard in his laborious and accurate paper of 1881. He describes the transitional phenomena of a number of Dicotyledons, among them *Tagetes erecta*. Not only is the transition in this species exactly the same as that in *T. patula*, but the author records a similar isolation of primitive xylem elements in *Raphanus niger*, *Ipomaea versicolor*, and *Datura Stramonium*, still treating the arrangement as exceptional.

These details are important, because if certain protoxylem elements belonging to the root are not continued upwards in regular succession into the cotyledonary or plumular bundles, but end abruptly in hypocotyl or base of cotyledon, there is not that complete correspondence between stem- and root-structure which is assumed in Van Tieghem's three types. In all of them the xylem and phloem bundles of the root are continued into the cotyledons or plumule. On their way through the hypocotyl they may divide or be displaced, and the xylem bundles "rotate"—that is, they turn on their own axes until the protoxylem is internal. But all the elements present in the root are continued upwards in regular succession, and are simply rearranged in the upper part of the seedling. This is one of the main arguments advanced by Prof. Van Tieghem to support his view that the steles of root and stem are identical.

According to most later observers, however, such temporary prolongation of the root-poles upwards as that described by Profs. Van Tieghem and Gérard in a few instances, and considered by them as exceptional, is really of general occurrence. The protoxylem elements, indeed, are not commonly isolated from the main xylem of the cotyledonary traces as in Tagetes, but are in more or less complete contact with them on either side. Such contact is approached in *Raphanus niger*, where it is very clearly suggested in Prof. Gérard's figures.

There is then a real difference of opinion on a question of fact between Prof. Van Tieghem and his school, on the one hand, and certain modern embryologists on the other. Three distinct views are now held as to the interpretation of the isolated xylem elements in the hypocotyl of Tagetes. I shall try to state them as fairly and concisely as possible.

Profs. Van Tieghem and Gérard treat Tagetes and the genera which resemble it as exceptional, because part of the external xylem of the root is continued upwards between the cotyledonary traces, and dies out in the base of the cotyledon. They consider that the remainder of the external xylem turns on itself and becomes internal in the usual way.

Prof. Gravis and his pupils think that a similar prolongation of the xylem poles of the root into the hypocotyl or cotyledon is the rule, and that they terminate there abruptly. But in most cases this vestigal root-xylem is not isolated; it is in contact on either side with the early xylem of the cotyledonary

[3] By this qualification I mean to exclude cases in which the young seedling is very greatly reduced.

traces, and is therefore apt to be confused with it. The characteristic shape of so many cotyledonary traces arises in this way. They are often called double bundles, but according to Prof. Gravis they are more than double, for each really consists of two traces in close contact with the last vestige of root-xylem. The latter always disappears higher up in the cotyledon, and the two traces may then unite into a midrib, with or without lateral branches. As a consequence of this view, Prof. Gravis considers that there is no morphological continuity in the hypocotyl between the vascular systems of root, stem, and leaf.[4] Their traces are merely in contact sufficiently intimate for physiological purposes. There can, therefore, be no true homology between the central cylinder of the stem and that of the root.

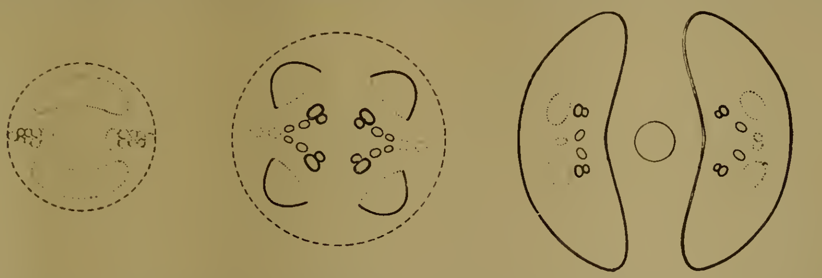
The third view is that of M. Chauveaud, who has been engaged for upwards of twenty years in following the development of the vascular elements in the hypocotylar region and its neighbourhood. He agrees with Prof. Gravis that the presence of external xylem is the rule in the hypocotyl and in the base of the cotyledon. But he considers that this external xylem belongs to the primitive structure of hypocotyl and cotyledon as well as to that of the root. We have already said that the vascular system of seedlings is first differentiated in the hypocotyl, base of cotyledon, and base of primary root. In all these regions M. Chauveaud thinks the primitive stele to be root-like—in his own phrase it belongs to the "disposition alterne." The xylem alternates with the phlöem, and its development is centripetal. This primitive formation, however, is permanent only in the root, and commonly in the lower part of the hypocotyl also. In the upper part of the hypocotyl and in the base of the cotyledons the first xylem elements are fugitive. They disappear so early that, as a rule, they are missed completely by the anatomist, who is apt to prefer well-differentiated tissues, and therefore to choose seedlings which are past their first youth.

In considering the theory of stelar evolution in which M. Chauveaud has correlated his own long series of observations with the results of other embryologists, I shall confine myself strictly to the question now under discussion—namely, the extent to which the stele of the young stem in Phanerogams can be considered to represent that of the root. Prof. Van Tieghem, as we have seen, considers them completely homologous, while Prof. Gravis denies that they are homologous at all.

M. Chauveaud occupies a middle position. If I understand his views rightly, he considers that there is an early phase in the development of the seedling in which the stele of the hypocotyl—at that time the only representative of the stem—is developing on exactly the same lines as the stele of the primary root, and is, in fact, continuous with it. At that epoch each cotyledonary trace is also developing on the same plan. It belongs to the same phase of evolution, and in many species of Dicotyledons the insertion of the cotyledons is the simplest imaginable. The original stele of the hypocotyl divides below the cotyledonary node, and one-half goes to each cotyledon.[5]

In species where this formation is clearly developed there cannot be said to be any transition between stem- and root-structure. Stem-stele and root-stele are continuous: their steles are developing in the same way. Even the leaf-traces of the first two leaves are on similar lines, and their insertion, therefore, does not modify the structure of the stele.

How, then, does the structure we associate with the stem of Phanerogams appear. In the transitonal region of the hypocotyl the first xylem elements—perhaps only two or three at each pole—alternate with the phlöem groups. The elements next differentiated lie within them, for development is still centripetal, but in two diverging groups. The xylem-ray is then shaped like an inverted V. Each arm of the V approaches the adjacent phlöem group as it travels inwards, until the last-formed elements lie on the same radius as the centre of the phlöem group, but well within it. The next elements are differentiated on that radius, but are directed towards the phlöem: development has become centrifugal. These successive xylem formations are called by M. Chauveaud the *alternate*, the *intermediate*, and the *superposed*. They are distinguished in the diagram by dotted lines for the alternate elements, thin lines for the intermediate, and thick lines for the superposed.



The alternate elements are fugitive in this transitional region; they commonly disappear as the superposed elements become conspicuous. The intermediate xylem persists. But higher up in the hypocotyl the intermediate elements, too, disappear as the seedling grows older. They vanish in the traces of the cotyledons also, and in the cotyledons themselves. Thus in seedlings of a certain age we have endarch bundles at the top of the hypocotyl, forming a stele of the stem type, and an exarch stele lower down, which passes unchanged into the root. The connection between the two is maintained by the intermediate xylem of the transitional region.

Although M. Chauveaud has been publishing his researches since 1891, yet he has only lately (1911) put his results into a connected form, and they are therefore less familiar than might otherwise be expected to anatomists who are not also embryologists. They clearly have a direct bearing on the theory of

[4] A. Gravis, "Recherches . . . sur le 'Tradescantia virginica,'" *Mém. de l'Acad. royal* . . . Tome lvii, Bruxelles, 1898. See account of hypocotyl (pp. 28–32), including insertion of cotyledon (pp. 31–32). Also memoir by same author on *Urtica dioica* (1885), footnote on p. 117. *Cf.* also Mr. R. H. Compton's paper in *New Phytologist*, xii., p. 13, 1912.

[5] Chauveaud, "L'Appareil Conducteur des Plantes vasculaires," 1911. See description of *Mercurialis annua* on pp. 216, 217, and figs. 62, 63.

the stele. Before, however, entering on this subject, I ought to say something on the question of fact. In my opinion M. Chauveaud's figures and descriptions represent the vascular development in the hypocotyl and cotyledons of Angiosperms more accurately than any others with which I am acquainted. He has dealt more fully with Dicotyledons than Monocotyledons, but I have been able to verify his account of the latter to some extent by reference to my own preparations, which include a number of species closely allied to those which he has cut. Among Dicotyledons I have had the great advantage of consulting the preparations of Miss Thomas and of Mr. R. H. Compton. Neither of these botanists made their preparations to illustrate M. Chauveaud's theory; indeed, they attacked the subject, as I did, with aims distinct from his. There has therefore, been nothing like complete verification in any single species, but so remarkable a correspondence with his figures in similar stages of the material, that I am satisfied of M. Chauveaud's fidelity.

Assuming, then, that his account of the vascular development in a young seedling is substantially correct, what are we to conclude as to the homology of the central cylinder of the stem with that of the root?

M. Chauveaud himself believes the stem cylinder in the upper hypocotyl of a fairly old seedling to be a true stele, but one belonging to a later phase of evolution than that of the root, and not, therefore, strictly homologous with it in the sense in which the earliest vascular formations in cotyledon and hypocotyl respectively were homologous with each other. He considers the successive vascular formations which we have just followed in these regions—formations marked by the appearance of alternate, intermediate, and superposed xylem in turn—to represent three successive phases of stelar development. The root-stele corresponds to the first of these phases only.

But questions of phylogeny are strictly historical, and the only precise meaning that can be attached to the expression "successive phases of stelar development" in the seedling of an Angiosperm is that at some past period a group of plants in the direct line of descent of Angiosperms possessed a stele resembling that which is now a mere stage in the life of the individual. Thus the alternate formation found throughout the very young seedling implies an ancestral group with an exarch stele in stem as well as root, and a leaf-trace of corresponding structure.

There is nothing at all improbable in this hypothesis, since groups with exarch steles in stem as well as root are found among living and extinct plants. But if adopted several important consequences would follow. The seedling while it consists of cotyledons, hypocotyl, and primary root only—the plumule present as a mere bud—must represent a past period in race-history when its ancestors possessed an exarch stele in stem and root alike; when the stem-stele belonged to the stem only, and the insertion of leaf-traces hardly modified its structure; when it entered the root without change, and therefore no transitional region occupied and puzzled the anatomist of the period.

This early stage in the development of the seedling is succeeded by that in which the epicotyl begins to grow, and as a rule the epicotyl is quite undoubtedly modern.[6] Its vascular skeleton is built up of leaf-traces, which are endarch from the first. At the cotyledonary node they are inserted on the vascular cylinder of the hypocotyl, which has become endarch at the top. This transition has been effected lower down in the hypocotyl, as described already, by the formation first of intermediate, and then of superposed xylem, together with the gradual disappearance of the original alternate xylem.

Thus the cotyledonary node may be considered to mark the interval between two acts in the drama of evolution—an interval the length of which cannot yet be estimated, but is clearly to be reckoned in geological epochs.

The race-history of the Phanerogamic stem-cylinder is at present unknown. How did the ancestral stele lose its exarch character, and what intermediate stages led up to its present construction from endarch leaf-traces? Possibly the development of the hypocotyl may give a clue as suggested by M. Chauveaud, and the change have been effected by the development of intermediate xylem. Or Prof. Jeffrey may be right in deriving the leaf-traces from a siphonostele which has been gradually more and more broken up by the appearance of foliar gaps. This process is said to be exhibited in the young epicotyl.[7] Until this point is cleared up the exact relationship of the vascular cylinder of the stem to that of the root will remain obscure. As a matter of convenience the stem-cylinder will, no doubt, be called a stele, even though anatomists should acknowledge that it cannot be considered as strictly homologous with the stele of the root. Much confusion of thought would, however, be avoided if the two structures were not treated as strictly comparable.

There can be very little doubt that the insertion of leaves has brought about the change, and I might suggest here that the insertion of leaves on an exarch stem-stele would be an interesting subject for research. The literature of the subject is scattered, and its treatment seems to me very incomplete. An exarch axis bearing leaves is, of course, exceptional, but more common among extinct plants than among recent species. So far as my very cursory examination of the literature has gone, it seems a general rule that the leaf-traces are inserted on the xylem poles of the stele.[8]

Hitherto I have considered modern embryology in relation to a single problem of internal anatomy—namely, the comparison of the vascular system of the stem to that of the root. But the evidence of embryology is also of great weight in questions of internal morphology and phylogeny.

Several questions of this kind are discussed by Hanstein, from whose classical paper I continue to date. For example, his account of the embryo of Monocotyledons suggests two distinct problems. One belongs to formal morphology—namely, the question whether a terminal member can be considered as a leaf. The other is a question of phylogeny: whether Dicotyledons are derived from a monocotylous ancestor or Monocotyledons from a dicotylus form. Both these questions I have discussed elsewhere,[9] and only refer to them now as examples of the way in which seedling anatomy has proved complementary to that of the older embryologists.

The most obvious interpretation of Hanstein's observations is that the single cotyledon of Monocotyledons is equivalent to the pair found in Dicotyledons. This would imply that Dicotyledons were

[6] The epicotyl in the *Viciea* has been described as containing centripetal xylem. The facts are given by Mlle. Goldschmid (1876), Prof. Gérard (1881), M. Chauveaud (1911) and Mr. Compton (1912). The theoretical interpretation is discussed by M. Chauveaud (*l.c.*, p. 348) and Mr. Compton (*l.c.*, pp. 93–95). There seems every reason to think, as Mr. Compton suggests, that the character is adaptive, depending on the twining habit. He points out that *Vicia Faba*, which does not twine, has a normal epicotyl.

[7] Jeffrey, "The Morphology of the Central Cylinder in the Angiosperms." *Trans. Canadian Inst.*, vi., 1900

[8] D. H. Scott, "Studies in Fossil Botany," 1908, p. 97 (*Sphenophyllum*); C. E. Bertrand, "Remarques sur le *Lepidodendron Harcourtii*," 1891, p. 109; M. Hovelacque, "Recherches sur le *Lepidodendron selaginoides*," 1892, p. 150; F. O. Bower, "Origin of a Land Flora," p. 334 (*Selaginella*), 1908; C. E. Jones, *Trans. Linn. Soc.*, ser. 2, vii., 1905, p. 19 (*Lycopodium*).

[9] E. Sargant, *Ann. of Bot.* xvii., p. 1, 1903, and *id.* xxii., pp. 150–2, 1908.

derived from an ancestor with one cotyledon, apparently terminal, which gave rise to the existing pair by a process of fission. But other interpretations were always possible, and the terminal hypothesis received a shock when Count Sohms-Laubach discovered that in certain Monocotyledons the single cotyledon is lateral from the first.

The comparative antiquity of Monocotyledons and Dicotyledons has been one of the first questions raised by the study of seedling anatomy. It is remarkable that both the hypotheses founded on work of this kind assert the greater antiquity of the dicotylous form. But if the cotyledonary member of Monocotyledons is derived from one or both cotyledons of an ancestral pair, it cannot be considered as terminal. Thus the evidence of seedling anatomy bids fair to settle both these questions, as I think it will settle others of the same kind mentioned by Hanstein.

The descriptive work of Irmisch and the school he represents has been carried on of late years by an American naturalist, Mr. Theo. Holm, with all the technical advantages given by modern instruments of research. His papers are commonly written with systematic intention, but the external characters of the species he describes are correlated with their internal anatomy, and the structure of the adult form is traced from its origin in the seedling. His monograph on *Podophyllum peltatum* is an example of this method, and illustrates its advantages in a very striking way. But it is becoming much more usual to compare the seedling with the adult form, as may be seen in two monumental works now being published in parts: "Das Pflanzenreich," edited by Engler, and "Lebensgeschichte der Blütenpflanzen Mitteleuropas," edited by Kirchner, Loew, and Schröter.

In a very useful paper on modern developments of seedling anatomy Mr. Compton has pointed out that the subject has been attacked from several divergent points of view. I have already referred to the work of M. Chauveaud and Prof. Gravis, and have now come to that of a number of English botanists, whose aim—as Mr. Compton observes—is mainly phylogenetic. They are even more clearly distinguished by their methods, which are those of comparative anatomy. Instead of following the development of the seedling of a single species from germination to the age at which its cotyledons begin to decay, as M. Chauveaud has done in a number of carefully selected instances, they have compared the seedlings of different species and different genera at about the same age, generally choosing the epoch at which the tissues of cotyledon, hypocotyl, and primary root are most completely differentiated. There is nothing new in this treatment of the subject. It was employed in 1872 by Prof. Van Tieghem [10] in his paper on the anatomy of grass seedlings, in which he compares them with other Monocotyledons of the same age. Much greater precision is possible, however, now that the microtome has come into general use.

The literature of this subject has increased rapidly of late years. The list of references in the footnote [11] appended to this paragraph is, I fear, far from complete. But it is not part of my plan to review this work critically. The time is, perhaps, not ripe for such a review, and certainly the time at my disposal to-day is quite insufficient for it. Perhaps I may be allowed to offer some general remarks, first on the method itself, and then on the criticisms it has encountered.

To compare the structure of organisms with each other is, of course, the recognised method of comparative anatomy, of systematic botany, and, in fact, of all branches of morphology. The great difficulty in all such work is to distinguish between adaptive characters of comparatively recent origin and the characters inherited from remote ancestors. The history of systematic botany is very instructive in this respect. Systematists discovered by degrees, and by means of repeated failures, that characters could not be picked out as important for purposes of classification on *à priori* grounds. No character is of uniform importance throughout vascular plants, for example. On the contrary, it may be of great value in the classification of one group and worthless in another, though closely allied. Generations of botanists have laboured to build up the natural system in its present form, and it is constructed from the ruins of abandoned systems. We all agree now that the guiding principle in all morphology is that our classification should represent relationships founded on descent only. But the natural system was complete in its main features before that principle was understood. It represented the feeling for real affinity developed in botanists by the study of plant form, independently of any theory as to the cause of such affinity.

This, of course, is the commonplace of botanical history, but we do not always realise that all morphological work is done under similar conditions. The only valid appeal from criticism is to the future: a new method is approved by its results. Therefore, to embark on a new branch of morphology is a real adventure. The morphologist risks much time and much labour. He knows that the evidence which he proposes to gather painfully, to test critically, to present logically, may, after all, prove of little consequence, and he has to depend on his own instinct to lead him in the right course. In his degree he resembles Columbus, to whom a few sea-borne seeds and nuts meant a new continent.

[10] Prof. Van Tieghem, *Ann. Sci. Nat.*, ser. 5, xv., p. 236, 1872.

[11] The following references are arranged alphabetically:—

Arber, A., The *Cactaceæ* and the Study of Seedlings. *New Phyt.*, ix., p. 333, 1910.

Compton, R. H., An Investigation of the Seedling Structure in *Leguminosæ*. *Linn. Soc. Journ. Bot.*, xli., p. 1, 1912.

de Fraine, Ethel. The Seedling Structure of certain *Cactaceæ*. *Ann. Bot.*, xxiv., p. 125, 1910.

Hill, A. W., The Morphology and Seedling Structure of *Peperomia*. *Ann. Bot.*, xxi., p. 395, 1906.

Hill, T. G., On the Seedling Structure of certain *Piperales*. *Ann. Bot.* xx., p. 160, 1906.

Hill, T. G., and de Fraine, Ethel. On the Seedling Structure of certain *Centrospermæ*. *Ann. Bot.*, xxvi., p. 175, 1912.

Hill, T. G., and de Fraine Ethel. On the Influence of the Structure of the Adult Plant upon the Seedling. *New Phyt.*, xi., p. 319, 1912.

Hill, T. G., and de Fraine, Ethel. A Consideration of the Facts relating to the Structure Seedlings. *Ann. Bot.*, xxvii., p. 258 1913.

Lee, E. Observations on the Seedling Anatomy of certain *Sympetalæ*. *Ann. Bot.*, xxvi., p. 727, 1912.

Sargant, E. A New Type of Transition from Stem to Root in the Vascular System of Seedlings. *Ann. Bot.*, xiv., p. 633, 1900.

Sargant, E. The Origin of the Seed Leaf in Monocotyledons. *New Phyt.*, i., p. 107, 1902.

Sargant, E. A Theory of the Origin of Monocotyledons, founded on the Structure of their Seedlings. *Ann. Bot.*, xvii., p. 1, 1903.

Sargant, E. The Evolution of Monocotyledons. *Bot. Gaz.*, xxxvii., p. 325, 1904.

Smith, Winifred. The Anatomy of some Sapotaceous Seedlings. *Trans. Linn. Soc.*, series 2. Bot. vii., p. 189, 1909.

Tansley, A. G., and Thomas, E. N. Root Structure in the Central Cylinder of the Hypocotyl. *New Phyt.* iii., p. 104, 1904.

Tansley, A. G., and Thomas, E. N. The Phylogenetic Value of the Vascular Structure of Spermophytic Hypocotyls. *Brit. Assoc Report*, 1906.

Thomas, E. N. A Theory of the Double Leaf Trace, founded on Seedling Structure. *New Phyt.*, vi., p. 77, 1907.

The references given above refer to Angiosperms only, but so much work of a similar nature has been done lately on Gymnospermous seedlings that I add a list of the principal papers:—

Dorety, Helen A. Vascular Anatomy of the Seedling of *Microcycas calocoma*. *Bot. Gaz.*, xlvii., p. 139, 1909.

Hill, T. G., and de Fraine, Ethel. The Seedling Structure of Gymnosperm. I., *Ann. Bot.*, xxii., p. 689 1908. II., *id.* xxiii., p. 189, 1909. III., *id.* xxiii., p. 433, 1909. IV., *id.* xxiv., p. 319, 1910.

Matte, H. L'appareil libéroligneux des Cycadies Caen, 1904.

Shaw, F. J. F The Seedling Structure of *Araucaria bidwillii*. *Ann. Bot.*, xxiii., p. 321, 1909.

Sykes, M. A. The Anatomy of *Welwitschia mirabilis*. . . . *Trans. Linn. Soc.*, 2. Bot. vii., p. 327, 1910.

Thiessen, Reinhardt. The Vascular Anatomy of the Seedling of *Dioon edule*. *Bot. Gaz.*, xlvi., p. 357, 1908.

Hence the difficulty of criticising recent work. When once a conclusion of some importance has been formulated it may be tested by evidence drawn from other branches of research. Until that time criticism from outside is of little value. Those who are working at the subject must, of course, form their own opinion on its possibilities, for each has to decide for himself whether he shall continue on those lines.

The subject of seedling anatomy is no longer very new. It is too late now to debate on the *à priori* probability of ancestral characters surviving in the young seedling. No one doubts that a vascular stump sometimes persists after the organ it originally supplied has disappeared.[12] Therefore there is no glaring improbability in the suggestion that the vascular skeleton of the young seedling may afford a clue to the structure of a remote ancestor. But this is only saying in other words that botanists are justified in giving the subject a fair trial. That trial is now proceeding. Some general conclusions have been formulated already, but they have not yet stood the test of time. In all probability the final judgment on this subject will be given by a future generation of botanists on evidence not as yet before us. In the meantime we shall all form our own opinion as to the prospects of the method. Speaking for myself, I think that it has already thrown much light on embryological problems, and is likely to throw more.

At the end of this very short and imperfect sketch of the progress of botanical embryology in recent years, it is natural to look back and attempt to estimate the importance of the whole subject and its relation to other branches of botanical science. I have treated it from the morphological side only, but clearly every department of botany must deal with the immature plant as well as with the adult form. For example, the struggle for existence between two species in any particular locality must be profoundly affected by the characters of their seedlings. If one species should gain a decided advantage over the other early in life, the vanquished species may never live to form seed, and may thus disappear from that neighbourhood in the first generation. This is an extreme case to show the importance of considering seedling structure in problems of ecology and distribution.

The internal structure of seedlings is certainly a department of vegetable anatomy, just as their adaptation to the conditions of life is a department of vegetable physiology. That the connection between embryology and systematic botany must be equally close seems at first sight to be beyond dispute, but the exact nature of that connection is as yet undetermined. In systematic botany we have the net result of an enormous mass of experience. Generations of botanists have examined and described the external characters of plants; they have arranged and rearranged them in groups until at last the instinct for affinity has been satisfied. In this continual sifting of characters some have been separated out as generally of systematic importance—the floral characters, for examples, and those of the seed. Certain features of the embryo are included among those characters, as already mentioned, but, on the whole, systematists have dealt exclusively with the adult plant. The embryo itself has been treated rather as a portion of the seed than as an individual.

It would be rash to assume that seedling characters have been disregarded by systematists because they were too busy with the fully-developed plant to pay proper attention to the young forms. In all probability some of the earlier botanists examined the external characters of seedlings and rejected them when they proved of little systematic value. But embryology, like the other branches of botany, entered on a new phase when the compound microscope came into general use. It was commonly denied that the anatomical characters of mature plants had systematic value until the test case of fossil botany was decided in favour of anatomy. We need not be surprised that conclusions drawn from the new embryology—that is, the embryology which includes internal characters as well as external—sometimes appear to conflict with the results of systematic botany, and it does not necessarily follow that embryological evidence is of no systematic value. The fault may lie with the embryologists, who, being human, do occasionally misinterpret their facts, or possibly the natural system may need some modification in the light of new knowledge. When both explanations have failed to account for the discrepancy in a number of cases we may be forced to give up looking for phylogenetic results from embryology.

And so in the end the appeal is again to Time, who as Milton says—devours

"No more than what is false and vain,
And merely mortal dross.
So little is our loss.
So little is thy gain."

[12] *Cf.* the discussion of the homology of the Orchis-flower in Ch. Darwin's "Fertilisation of Orchids," chap. xiii., p. 2?5 in second ed., 1888.

SECTION L.

EDUCATIONAL SCIENCE.

FROM THE OPENING ADDRESS BY PRINCIPAL E. H. GRIFFITHS, LL.D., F.R.S., PRESIDENT OF THE SECTION.

We have now had forty years' experience of compulsory education, and more than ten years' experience of the working of the Education Act of 1902. We are spending at the present time out of the rates and taxes about thirty-four millions per annum upon education. It seems reasonable, as a nation of shopkeepers, that we should ask if we are getting value for our money, and the reply will, of course, depend on what we mean by value, for the man in the counting-house, the man in the street, and the man in the schoolroom all have different standards of valuation.

Some of us are old enough to contrast the position of to-day with that of forty years ago. Do we observe any definite advance in knowledge, intelligence, character, or manners, as compared with the pre-compulsory days? We must all be aware of the tendency to magnify the past at the expense of the present, but, after making due allowance for the fact that "the past seems best, things present ever worst," it appears difficult to find distinct evidence of improvement in any way commensurate with the sacrifices which have been made.

I have taken every opportunity of ascertaining the views of men of varied occupations and differing social positions upon this matter, and I confess that the impression received is one of universal discontent. The complaints are not only of want of knowledge, but also, which is far more serious, of want of intelligence. Consider a trivial example drawn from my own experience. I am a motorist in a small way. My ambition has been restricted in the matter of chauffeurs to lads fresh from our elementary schools, whom I have employed for what I may summarise as washing and greasing purposes. Some six or seven of such lads have passed through my hands during the past nine years, and all of them have been at a primary school for some seven or eight years. They came with good characters, and all had passed up to the fifth or sixth standard. None of them could spell correctly, keep simple accounts, or appear to derive any enjoyment from reading.

Nevertheless, two of them, at all events, gave evidence of a real liking for mechanics, and within a year or so could be trusted to take the engines to pieces, clean them, and replace them with but little supervision. It might be argued that although they had imperfectly acquired the rudiments of "the three R's," the aptitude of these lads was the result of their training. Of this, however, I could find no evidence. It is difficult to understand how these boys could have profited so little by their many years of school life. If such an example is in any way typical, it is time to consider what the country is obtaining in return for the thirty millions annually expended on elementary education alone.

It may be thought that I have been unfortunate in my experience. I do not, however, believe that my case *is* singular. In *The Contemporary Review* for July, 1909, Prof. Stanley Jevons contributed an article on "The Causes of Unemployment." He referred therein to the opportunities afforded him by University Settlement Boys' Clubs in London and Cardiff of forming a judgment concerning the products of our primary schools. He described the following experiment:—

"I arranged to test a few members of the Boys' Club. They were gathered in a room with pens and papers and were asked to write down the following short sentence, which was spoken to them distinctly twice, as an example of the kind of message which they might be expected to have to write occasionally for an employer: "I have not been able to find the book which you sent me to fetch." The test was one both of memory and spelling, and most of the boys failed in one or both respects."

Prof. Jevons gave facsimiles of the results, which I am unable to reproduce; but I can indicate the nature of the spelling. It will be noticed that there are no words of two syllables. The following is the best of the batch:—

Boy aged nearly sixteen: "I cannot (fetch) find the book which you sent me to fetch."

The following are from boys aged fourteen and fifteen respectively:—

"I have not been *abele* to find the *boock whi witch* I sent you (for) to *fitch*."

"I have Not *bend* able to find the book *With* I sent you to *fath*."

All these boys have been through one of our large primary schools.

Prof. Jevons added: "In contemplating the question of unemployment one is at once led to the conclusion to which so many other economic problems ultimately lead—that the only certain means of abating the evil is the improvement of the individual."

Passing from such limited experiences to the views of those who are brought into contact with the products in bulk, a sense of dissatisfaction and uneasiness is no less evident. Consider the following extracts from the presidential address of Mr. Walter Dixon, to the West of Scotland Iron and Steel Institute in October last:—

"I have, over a somewhat extended period and a wide area, made inquiries amongst those who have the control of about 200,000 men in our own allied industries, with the following results:

"It is the unanimous opinion that any book-learning outside the rudiments of 'the three R's' is considered a matter outside the requirements of the education of more than 90 per cent. of the usual manual workers. In other words, the work that these men are called upon to do, the labour which they have to perform in their daily avocation, would be as efficient, as successful, and as expeditiously performed if the men had no school education whatever outside 'the three R's.'"

If there is any truth in this severe indictment there is small cause for wonder if a general sense of uneasiness exists amongst those who consider that the future prosperity and safety of this country are dependent on the manner in which we train the rising generation.

In justice to Mr. Dixon I must give a further extract from his address:—

"During the recent meeting of the British Association in Dundee I spent some time amongst educational authorities, not only those belonging to our own country, but delegates from other nations, and I find that they themselves are beginning to see the futility of the present methods and to realise that they are ploughing the sands. Amongst other matters, it was of interest to note that they are at present promulgating a scheme for what they call vocational education. In other words, I gather that they are now attempting in a modified way to replace the old 'prentice system by teaching trades in their schools, so that children may enter the trades as skilled workers—a system which, to my mind, would render the present confusion more confounded. . . . We must recognise that the mechanical developments of the last half-century have done away in a large measure with the possibility of the interest which man could once take in his daily work, inasmuch that few men now make anything, but only a *small portion of something*. A statement was made at Dundee that 135 different persons were employed in the making of a boot. It is not to be expected that any of these 135 workers can get enthusiastic about their particular bit. We must recognise that as long as we live under the reign of industrial competition the hours of labour are likely to be hours of stress, and that when a man has finished his labour it is only right, it is only human, that he should have hours of reasonable recreation. It is with a view of making these hours of recreation worthy of the nation to which we belong that I feel that our educational methods might, and ultimately will, be altered and rendered valuable."

If I may venture to summarise Mr. Dixon's address as a whole, it appears to me that the argument is somewhat as follows: It is admitted that "the three R's" are necessary for all workers, of whatever grade, almost as necessary for the mental as are sight and hearing for the physical equipment. A large majority of manual labourers, however, are not rendered any more efficient in the discharge of their tasks by further instruction of an academic character, and therefore we should aim at providing them with some form of education which would so quicken their intelligence as to enable them to find an interest in matters external to their employment and thus lead them to utilise their hours of creation in a sane and healthy manner. It should be our object not so much to train all our soldiers as if they were to be generals, as to give them that education which would make them good soldiers, and to spare no expenditure of time or money in the further education and development of the small percentage who have shown those qualities which lead, under proper guidance, to high achievement.

The assumption that all children are fitted to profit by more than the rudiments of academic education is, I believe, responsible for many of our present difficulties. In physical matters we seem to be wiser. We take account of bodily disabilities; we do not train lame men for racing, or enter carthorses for the Derby; we do not accept the short-sighted or the colour-blind as sailors; but those who talk of compulsory further education appear to think that all men are on an equality as regards mental equipment. Democracy in its control of education counts noses rather than brains, I observe, for example, that the education committees, on which I have, or have had, the honour of serving, are unwilling to continue those higher technical classes in science in which the numbers are necessarily small. A class of four in higher mathematics will probably be discontinued, whereas a class of one hundred in shorthand will be regarded as a highly successful achievement.

Such education committees, however, are only carrying out what is apparently the policy of those sitting in the seats of authority. A nation which expends but four millions for the encouragement of higher education and research and thirty millions on the rudiments cannot be said to lend that recognition, assistance, and encouragement to the best brains of the country which is the one form of educational outlay which is certain to bring, as Mr. Wells has truly indicated, not only the best return industrially, but also an immunity from invasion otherwise unobtainable.

It is possible that the views taken by Mr. Dixon and the employers and business men whose opinions I have attempted to gather are unduly pessimistic. I have, therefore, turned naturally to the teachers, with many of whom I am brought into contact.

I find, on the whole, much the same spirit of pessimism prevailing. I can only recollect one gentleman—a teacher of long experience and high standing—who takes a brighter view of the position. According to him, the children leave our schools better instructed, more intelligent, and better mannered than was the case some twenty years ago.

It is true that teachers as a body agree that there has been one real advance—viz., the abolition of the system of payment by results—but many of them admit that during the past ten years progress, if any, has been slight. They plead in extenuation that the large size of the classes is in itself a barrier to real efficiency, and that the teacher is so fettered by regulations, so bothered by the fads of individual inspectors, that we ought to be gratified, rather than disappointed, by the results achieved. It is a significant fact that the supply of teachers for our primary schools is diminishing, and that, as a necessary consequence, the proportion of fully trained and qualified teachers, although increasing, is unduly small. The attractions of the profession are undoubtedly insufficient. When we consider the meagre salaries, the slow, very slow, promotion, the few prizes and the slight social recognition, it is a surprising fact that so many able men and women are prepared to accept the lot of teachers in our primary schools.

The teaching profession, if profession it can rightly be termed, compares unfavourably with the so-called learned professions. It is noticeable that but few of our primary school teachers are prominent in civic affairs. Their representation on education committees, for example, is quite inadequate; during the discharge of their duties they are unable to mix with their fellow-citizens, and thus gain experience in the same manner as the clergyman, the doctor, or the solicitor. The regulations practically forbid participation in public life, and the teachers' activities are regarded as bounded by the walls of the schoolroom.

If the results of our educational system are disappointing, it is not for us to throw the blame on the teachers. Until we learn that satisfactory results can be obtained only when the life and emoluments of the schoolmaster are such as to offer avenues to distinction comparable with those of the learned professions, we cannot hope to attract into what should be, after all, the most important of all professions, the best brains and energies of the community.[1]

Undoubtedly, however, we *have* made advances within the last generation. Our outlook is different, but we are expecting higher achievement without affording that inducement which entitles us to demand it. Our industrial needs have impressed upon us the necessity of a wider view of the meaning of the word "education." We are slowly learning that we should aim at the awakening of the intelligence, rather than at the mere imparting of knowledge by what I might term force-pump methods. Forcible feeding is not proving a success either physically or mentally.

Some fifty years ago a leading name in the educational world was that of Todhunter—a name which I admit was regarded with terror rather than affection by many of us in our school days. As a correction to pessimism I venture to inflict upon you the following extract from Todhunter's "Conflict of Studies," published in 1873:—

"It may be said that the fact makes a stronger impression on the boy through the medium of his sight, that he believes it more confidently. I say that this ought not to be the case. If he does not believe the statement of his teacher—probably a clergyman of mature knowledge, recognised ability, and blameless character—his suspicion is irrational and manifests a want of the power of appreciating evidence, a want fatal to his success in that branch of science he is supposed to be cultivating."

I take a singular pleasure in this extract. In times of depression it serves as a tonic and drives one to the conclusion that, after all, our progress, however slow, is real, although I have an impression that the Todhunter school is not entirely extinct.

So far, the only result of my inquiries has been the discovery, if discovery it was, that dissatisfaction with our present system was the prevailing sentiment. I decided, therefore, to take the somewhat bold step of endeavouring to ascertain the attitude of those who have most to do with the administration thereof. I ventured to send to all the directors of education in England and Wales a series of questions, the answers to which I hoped might throw light on the matter. In order to elicit, if possible, free expression of opinion I stated that their replies would in general be used only for statistical purposes, and in no case would indication be given of the authority with which the writer was concerned.

I take this opportunity of most sincerely thanking the many directors who have been so good as to assist me in this inquiry. No fewer than 121 of these gentlemen have undertaken the task of returning replies, and when I reflect upon the extent to which their energies are employed in compiling returns for their various authorities and for the Board of Education, I realise my temerity in thus adding to their labours.

In analysing the replies it has been necessary to divide them into the following classes, viz.: (1) Counties, (2) county boroughs, and (3) boroughs and urban districts, as the conditions in these areas, under the Act of 1902, differ considerably.

We must remember that as the directors of education have to work the machinery, they are perhaps in a better position than any others to form a judgment as to excellences and defects. True, they look on the matter through official spectacles, which are always more or less tinted, and they may, like many owners of motor-cars, have a tendency to hide imperfections.

[1] It appears that our average expenditure per child per working week (including interest on buildings, &c.) is about 1s. 8d. Perhaps we are getting in return as much as we deserve at the price.

In Class 1 (counties) I received replies from thirty-six directors; in Class 2 (county boroughs) from forty; and in Class 3 (boroughs and urban districts) from forty-five.

The authorities concerned are fairly representative of all portions of England and Wales, and both of rural and urban districts. In order to render comparisons possible, I express the nature of the replies in percentages of the whole of the class. I believe, however, that the effect of reading out, in circumstances of this kind, a large number of tables containing numerical data would be to occupy a considerable portion of your time, and yet leave but little definite impression. I have, therefore, given these tables as an appendix to this address, and will now only trouble you with a reference to the results and some examples of the interesting remarks included in the replies.

My first question was :—

I. "Do you consider that the centralisation of authority in the hands of county councils has caused any decay of interest in education in your district?"

Reference to Table 1 will show that while in large areas the effect of the Act has been to stimulate interest in educational matters, in small boroughs and urban districts the reverse has been the case. It is difficult, however, to classify strictly many of the replies, as will be seen from the following examples.[2]

As a natural sequence to this interrogation I made the following inquiry, namely :—

II. "Would you prefer the educational authority to be one elected *ad hoc*, as in the days of the school boards, rather than the system as at present established?"

As might be expected, those directors who considered that the present system has caused a decay in local interest are, with some few exceptions, in favour of a return to an authority elected *ad hoc*. Replies in the affirmative form a large proportion of the whole, no less than 72 per cent. of the boroughs and urban districts being in favour of a return to the old system. In considering the answers to both these questions it should be remembered that previous to the Act of 1902 counties, as such, had no experience as regards primary education.

The Act of 1902 gave to the county councils, as regards the constitution of their education committees, considerable powers of cooption. I was anxious to find to what extent this power had been utilised, and, therefore, my third question was :—

III. "To what extent has cooption of members of the education committee been adopted in your area—*i.e.* what proportion do the coopted members bear to the whole committee, and what is the proportion of coopted women members?"

The average percentage of coopted members is curiously equal in all three classes—viz. thirty-one, thirty-three, thirty. The highest percentage is forty-eight, and the lowest three. It is noticeable that the percentage of coopted members is less in Wales than in England. A reference to the tables will show that a considerable number of directors are desirous that the principle of cooption should be extended.

My fourth question was :—

IV. "Have your local committees, or bodies of school managers, the right of appointing (*a*) head teachers, (*b*) assistant teachers?"

I find that, as regards head teachers, more than one-half of the counties, one-third of the boroughs, but only a small proportion of the county boroughs, have delegated all powers; the right of appointing assistant teachers being delegated to a slightly greater extent.[3]

The general result of the replies indicates that the power of appointment is unsatisfactorily exercised by local bodies of managers.

V. "Has the authority established a college for the training of elementary teachers, under its own management, or in conjunction with others?"

I find that as large a proportion as one-seventh of the authorities (counties and county boroughs) whose directors have returned replies have established training colleges. It does not appear, therefore, as if the present dearth of teachers was due to lack of training facilities.

I was anxious to ascertain if the effect of such local training colleges was to restrict the freedom of teachers, and the sixth question was as follows :—

VI. "Is the general effect of the present system to restrict the freedom of choice of teachers to those from your own locality?"

In about half the counties the answer is in the affirmative, and in the county boroughs about four-fifths.

It would appear that, on the whole, the opinion of directors is that the effect of the establishment of local training colleges has been to encourage the evil of what I may term "inbreeding."

VII. "Do you consider the curricula of (*a*) primary, (*b*) secondary, schools under your authority as overcrowded? If so, can you indicate the directions in which you consider there could be a reduction?"

Rather more than half of the authorities consulted considered that the curricula of the elementary schools are overcrowded, and rather more than a third are of the same opinion as regards the curricula of the secondary schools.

VIII. "Are you in favour of an increase in the number of vocational schools? Or do you consider that the effect of such increase would be detrimental to the standard of general education throughout the country?"

One-third of the county directors consulted, and almost half of those of the county boroughs and boroughs, answer in the affirmative, whereas rather more than one-fifth state their inability to arrive at a conclusion. A number of those who answer in the affirmative qualify their replies by stating: "For children over fourteen," or "General education must be first considered," "Provided general education is continued."

As a whole, the weight of opinion is strongly against any increase in vocational schools for children who have not completed their primary education.

IX. "What is the average size of the classes in your primary schools?"

I find that the average size of the classes in the counties is thirty-four, and in the boroughs forty-two, and they vary from over sixty-three down to ten. The smaller average in the counties is evidently due to the large proportion of rural schools.

My next question concerned the counties only. I was anxious to ascertain the effect of the clause of the Act which places on the locality the task of finding the greater portion of the money for additional buildings, viz. :—

X. "Do you consider Par. 18, 1 (*a*), (*c*), (*d*) of the 1902 Act to work harshly or to the disadvantage of educational progress?"

It appears that some 40 per cent. of the directors are of opinion that the effect of the clause is unsatisfactory. It must be remembered that it is not probable

[2] The examples referred to will be found in the address as printed in full and issued by the British Association.

[3] As regards non-provided schools, in all cases (by the Act) the power of appointing head teachers is in the hands of the managers.

that the officials of county councils would regard this matter from an impartial point of view, for, no doubt, the existing conditions lighten the burden of the county rates. It is somewhat surprising that in such circumstances the percentage of those answering in the affirmative is so large.

XI. "Has your council delegated to your education committee all the powers permitted by the Act? If not, are you in favour of such delegation?"

I find that while over 90 per cent. of the county authorities have delegated all powers, less than one-half of the county boroughs and three-fifths of the boroughs and urban districts have adopted the same course. An overwhelming majority (85 per cent.) of the directors of all classes are in favour of full delegation.

XII. "Please add any special criticisms of, or suggestions for, improvements in the Act."

It was very evident that most of my correspondents were anxious to avoid an expression of their views in this matter. The nature of many of the replies may be indicated by that of one of the directors—namely, "No, thank you." On the other hand, several have been so good as to write me short treatises on the subject, containing very valuable expressions of opinion. It is difficult, however, to quote from many of these without betraying the condition on which I invited confidence—namely, that I would give no indication as to the localities concerned. On one matter all who have expressed their opinions are in accord, viz.: "The greatest difficulty of the Act is the dual control for non-provided schools, more especially with regard to staffing."

It is stated that "the transfer and promotion of teachers is almost impossible under the present system." I feel, however, that the less I touch on this aspect of the matter the better for the peace of mind of this section. Again, all directors urge the necessity of relieving the increasing burden of the rates. One states that the proportion of Treasury grants has dropped from 66 per cent. in 1906 to 48 per cent. in the past year, while the local rate has been nearly trebled. Again: "Some means should be obtained to enable authorities with a large number of rural schools to provide adequate education without increasing the overwhelming burden now imposed upon them."

I may sum up as follows the impression left on my mind by the study of all the replies, of which I have given only a few examples.

1. The Act appears to give greater satisfaction in the counties than in the county boroughs and boroughs and urban districts, although even in the counties the position of the smaller rural schools is a cause of dissatisfaction.

2. That in the boroughs there is, on the whole, a preponderance of opinion in favour either of an authority elected *ad hoc*, or a more liberal exercise of the power of cooption.

3. That there is a preponderance of opinion that the appointments of school teachers should in all cases rest in the hands of the L.E.A.

4. That there is a tendency under the present system, except in centres of large population, to restrict the choice of teachers to those who have received their education locally, and that the effect of such restriction is detrimental.

5. That greater freedom in educational matters is advisable. The effect of the present system is to produce a dull uniformity, although it is doubtful whether the head teachers themselves or the Board of Education are most to blame.

6. That an increase in the number of vocational schools is not desirable, unless great care is taken that only those scholars are admitted who have received a sound general education.

7. That one of the greatest hindrances to progress is the large size of the classes.

8. That there should be a greater delegation of powers to the education committees, and that the L.E.A. should have complete control over all forms of education within its own area.

9. That a Redistribution Bill in the matter of areas is desirable, especially in the relation of urban areas to the rural districts connected with them.

10. That the dearth of fully qualified teachers cannot be remedied until the profession is made sufficiently attractive by increased emoluments and more rapid promotion. Mere increase in the number of training colleges is no remedy.

11. And, lastly, there is a consensus of opinion that a greater proportion of the cost of education should be borne by the Treasury, and that the danger to education arising from the rapid rate of increase in the education rate is a very real one. If education in this country is to be successful it must be made popular. This is impossible when every step in advance means an addition to the local burdens.

I am afraid that the tenor of this correspondence does little to modify the pessimistic views to which I have previously directed attention. Regarded in bulk it conveys the idea that the writers are endeavouring to make the best of a bad case. As shown by the last reply quoted (*supra*), the race of Mark Tapleys does not appear to be entirely extinct.

I wish it had been possible to obtain the confidential opinion of H.M.I.s, but I, at all events, am not one who would dare to question the gods, the distinguishing characteristic of those admirable officials being a cold infallibility which renders approach inadvisable. It must be remembered, however, that veiled hints of the need of drastic reforms have emanated from the highest quarters, and one of the most hopeful signs of the situation is that such information as has been vouchsafed to us appears to indicate that those who are moving in the matter actually acknowledge that there is an educational as well as a sectarian and a political aspect of the question. Nevertheless, so far as I am personally concerned I still find my chief consolation in the quotation from Todhunter which I have already inflicted upon you.

I am now going to take a bold step—namely, to express my own opinion on this matter of primary education. I consider that we are proceeding in the wrong order, in that we give greater prominence to the acquisition of knowledge than to the development of character.

There is truth in Emerson's dictum that "the best education is that which remains when everything learnt at school is forgotten." We appear to think that the learning of "the three R's" *is* education. We must remember that in imparting these we are only supplying the child with *means* of education, and that even when he has acquired them the mere addition of further knowledge is again not education. If we impart the *desire* for knowledge and train the necessary mental appetite, the knowledge which will come by the bucketful in after life will be absorbed and utilised.

It is, I know, easy to talk platitudes of this kind. We have, in justice to the teacher, to remember that character depends on home life, as well as on school life; but, nevertheless, if we could educate public opinion on this matter progress might be possible. We want to introduce the spirit of our much-abused public schools into all schools, namely, a sense of responsibility—and, as a necessary sequence, a sense of discipline—a standard of truthfulness and consideration. In this connection I have been greatly impressed by a report issued by the Warwickshire County Council on the effect of the establishment of the prefect system in the elementary schools of that county, and I wish it was possible to place this report in the hands of every teacher in the country. It is stated in the introduction that "the fundamental idea of the prefect system is the formation and development of character and the utilising for this purpose of the efforts and activities of our pupils themselves."

The pamphlet contains a description of the system as established, and the different methods adopted in the schools of the county in carrying it into effect.

A summary of the head teachers' remarks, compiled by the Director of Education, is given as an appendix, and I cannot resist the temptation to quote largely from his report:—

"In the autumn of 1911 a conference of head teachers was held on prefect systems in elementary schools. It was then decided that all the head teachers present should try the system for a year, each one on his or her own lines, and then report as to its working.

"Nearly all have now made reports, one only having failed without good cause. Reports have come in from six large or middling boys' schools, three large girls' schools, two large mixed schools, mostly in villages, and one infants' school—twenty-three in all, embracing schools of practically every type.

"The record, with one exception, is a story of success, in most cases of extraordinary success, so much so as to put the possibility and value of the system beyond a doubt. Whether in developing the prefect's own character, or in creating a sense of school honour among the other children, or in smoothing the whole working of the school, the result is equally striking. And the more ambitious the scheme of a school, the more it approximates to the public school tradition, the bigger the faith in boy and girl nature, the greater has been the success. The few evidences of comparative disappointment come from schools where the system has been tried haltingly and with distrust. Where there has been courageous faith in the children they have risen to it to a degree that must surprise even those who were readiest to believe in school self-government. Nor is the success confined to large schools or boys' schools. Boys' and girls' and mixed schools, town schools and village schools, all have the same tale to tell. A supply teacher who has served in seven schools since the conference has found that 'from all classes of children, town and country, a ready response is made to an appeal for added responsibility and trust on their part.' . . .

"The prefect, being in authority himself, comes to see the necessity and value of discipline. He is as keen as is his head for the school's honour; he worries the unpunctual, he takes charge of the playground. He is proud at being asked and able to help in matters of school routine, most of all when the teacher is called out of the class-room and he is himself responsible for order. And woe then to the disorderly or slack! . . .

"In its way one of the most remarkable applications of the system is its appearance in a miniature form in an infants' school. Children of six and seven, happy in the possession of the monitor's bow of ribbon, take care of the younger children and remove dust which has escaped the caretaker's eye. . . .

"It is a moot point whether a written constitution helps or not. Some teachers deprecate rules, as limiting a prefect's sense of responsibility and his freedom to follow out his own ideas. That rules, however, meet some want seems to be proved by the fact that at a school where the head master had purposely made none the boys themselves drew up their code, and, the head master adds: 'I could not have got out any better rules.'"

The origin of the movement the results of which are thus described is due to the man whom I regard as the greatest educator of our time—namely, Sir Robert Baden-Powell. I believe that the Boy Scout movement is rendering greater service than our complicated State machinery in preparing those who are brought within its influence for the struggles of life. It is a matter for regret that so small a fraction of the children in our schools is able to share its benefits. I only wish it were possible for our political system to admit the appointment of Baden-Powell as Minister of Education, with plenary powers, for the next ten years!

He states that when visiting a great agricultural school in Australia he asked the principal to inform him briefly what was the general trend of his training. The reply was: "Character first; then Agriculture."

If this, suitably modified, could be adopted as the motto for all our schools, the present attitude of the man in the street towards education would soon undergo modification.

There is truth in Dr. Moxon's statement that "A man has to be better than his knowledge, or he cannot make use of it," and our efforts should be mainly directed to making the character and the intelligence of the child so much better than his knowledge that increase in knowledge will follow as a matter of course. Let us devise some kind of universal junior scout system which may so brighten the intelligence that the boy will *want to know*. Let him also discover that the paths to knowledge are reading, writing, and arithmetic; he will then gladly follow his guides and gather more by the way than when he is pushed along those paths in a perambulator.

So long as we attach greater importance to the results of examination than to the judgment of the teacher our system stands self-condemned, for it places knowledge above character.

It is natural that the discontented amongst us should try to cast the blame on those in authority, and I confess that at times I feel as if I could join the militant section and relieve my feelings by throwing stones through the windows of the Board of Education; but in recent years I have been privileged to pass to the other side of those windows, and I have, to some extent, been led to realise how able and how devoted are the men to whom the guidance of our educational system is entrusted. All who are brought in contact with them must acknowledge their earnestness and their zeal in the cause in which they are enlisted, and it is remarkable how, in the discussion of educational questions, they can, in moments of partial *abandon*, cease to be strictly official and become almost human. It is evident, however, that the aim of such men must ever be the smooth working of the machine as a whole. The comforting words "coordination," "uniformity," "efficiency," are ever in their minds. A system planned on one great design and perfected in all its details is the ideal for which they are bound, consciously or unconsciously, to strive. The pity of it is that the more successful their efforts, the worse it is for education in this country.

Evolutionary progress is only possible where variety exists, and variety is necessarily abhorrent to the official mind. Freedom for local authorities to adopt their own methods, to experiment—and often to fail—is the system, if system it can be called, by which alone advance is possible. The curse of uniformity, perhaps the greatest curse of all, is a necessary consequence of over-centralised control.

I have trespassed so greatly upon your forbearance in discussing matters connected with primary education that I must give but brief expression to any views concerning the secondary and higher branches.

As I have previously indicated, State aid should be restricted to those who are able to profit thereby. The 25 per cent. free-place regulation has, it is generally admitted, brought into the secondary schools many really able students. On the other hand, there is no doubt that a certain proportion thereof would be more profitably employed in serving their apprenticeship in the business in which they are to earn their bread-and-butter. It is, of course, understood that those whose parents can afford to pay for the further education of their children and who are ready to do so are not here referred to, but, careful selection assured, generous assistance to those in need of help suggests itself as the best policy.

Another subject for consideration is the disproportion between the assistance given by the State to the training of primary and of secondary teachers. I understand that to the latter object, so far as England and Wales are concerned, the not impressive sum of 5000*l*. is delegated. After making due allowance for the difference in numbers under the respective headings, it is difficult to understand how it is necessary to expend a sum approaching 700,000*l*.[1] on the training of primary teachers, and only 1/140th of that amount on training those who are to guide our most able students in the pursuit of knowledge.

Had time permitted I should have liked to dwell on the evil effects of what I may term our conspiracy of silence regarding sexual instruction. If the proverbial visitor from Mars was engaged in a tour of inspection in our country, I think nothing would strike him as more extraordinary than that a subject which so closely concerns the progress of the race and the welfare of the individual should be entirely ignored in our system of education. By our action (or rather want of action) we tacitly admit that knowledge is harmful, and that we deliberately prefer such knowledge, which must necessarily be attained in one way or another, to arrive by subterranean channels and by agencies which will present facts of vital importance in their worst possible aspect.

We cannot be said to be really educating our children so long as we withhold from them all guidance in one of the most difficult problems which will be presented to them in later life, and when one reflects on the misery and wreckage consequent on our silence, it is difficult to speak with due moderation. I will therefore content myself with suggesting to those interested in this matter a study of the procedure adopted in the schools of Finland, in which systematic instruction is given by carefully selected teachers; it is stated with the happiest results.

I have referred, when speaking of primary education, to the curse of uniformity as one of the greatest evils of our educational system. So far, at all events, our provincial universities have escaped, although not entirely unscathed, from the cramping effects of departmental control. The situation, however, is not free from danger. It is necessary that these universities should be State-aided. It is also evident that, if we are to hold our own in competition with other nations, State assistance must be increased. There is danger, therefore, that the blight of uniformity and official control may descend upon them. The danger is not immediate, but it is nevertheless real. To some of us an ominous sign was the transference of the dispensation of the university grants from the Treasury to the Board of Education. It is true that we have evidence that no desire for undue control is manifest at the present time, and it is an encouraging sign that the Minister of Education, in a recent dispute connected with one of our youngest universities, intimated that he considered it beyond his province to interfere with its proceedings.

In this connection Mr. Austen Chamberlain has given me permission to read the following extract from a letter which I recently received from him:—

"I am in complete agreement with you as to the importance of preserving to the universities the greatest possible freedom and liberty. For this very reason I was at first strongly opposed to transferring the administration of the Treasury grants to the Board of Education; but I found that, for one reason and another, a considerable portion of their receipts were already received from the latter Board, and it was represented to me that this involved unnecessary complication and overlapping, and that the universities were likely to receive more generous consideration if the whole of the grants were placed in the hands of a single authority. At the same time I was assured that the Board of Education had no desire to claim a control different in character or extent from that which the Treasury had previously exercised. On receiving these assurances I withdrew my opposition to the transfer and sent word to the Chancellor of the Exchequer that I no longer held him bound by an undertaking which he had given me in the House of Commons that the transfer should not take place."

Another encouraging sign is the *personnel* of the Advisory Committee which the Board has established to guide it in matters connected with the University grants. We cannot, however, be certain that such wise views will always prevail, and I have already dwelt on the inevitable tendency of any department of State to influence and control the policy of all bodies receiving assistance from the Treasury.

The freedom of the universities is one of the highest educational assets of this country, and it is to the advantage of the community as a whole that each university should be left unfettered to develop its energies, promote research and advance learning in the manner best suited to its environment. It is conceivable that it might be better for our universities to struggle on in comparative poverty rather than yield to the temptation of affluence coupled with State control.

The State is at present devoting some 180,000*l*. to the support of university education in England and Wales. If, in addition, we include such institutions as the National Physical Laboratory and the grant of 4000*l*. to the Royal Society, we may say that this country is expending about 200,000*l*. per annum on the highest education and the promotion of research, a total but slightly exceeding that devoted to *one* of the universities of Germany. Comment appears needless.

When we reflect on the magnitude of the results

[1] Note I.—Grants for 1911–12:—

1. Grants from Board of Education:—		
(*a*) Maintenance grants to training colleges and hostels	£470,910	
(*b*) Building grants	93,406	
		£564,406
2. Grants from L.E.A.'s:—		
(*a*) To training colleges	21,682	
(*b*) To hostels	787	
(*c*) Scholarships (not possible to ascertain total)	?	
		22,469
Total		£586,875

Note II.—To the above must be added the grants in aid of bursars and pupil teachers, which amount to £101,802.

which would inevitably follow an adequate encouragement of research, the irony of the position becomes more evident. It was stated on authority that Pasteur during his lifetime saved for his country the whole cost of the Franco-Prussian War. It is computed that nearly one and three-quarter millions of our population are to-day dependent for their living upon industries connected with the mechanical generation of electricity—a population which may be said, without undue use of imagery, to be living on the brain of Faraday. We possess mathematicians who, granted encouragement, opportunity, and time, could establish laws of stability of aëroplanes. Suppose we spent some millions in discovering *the* man and enabling him to complete his task; the result might be an addition to our security greater than that of a fleet of super-Dreadnoughts. Unfortunately, there are no votes to be gained by the advocacy of opportunities for research!

Associations such as ours should spare no effort to bring home to the minds of the people the truth of the statement that the prosperity of this kingdom is dependent on its industries, and that those industries are founded on applied science.

Some years ago the *Petit Journal* invited its readers to answer the question, "Who were the twenty greatest Frenchmen of the nineteenth century?" No fewer than fifteen million votes were recorded. The resulting list included the names of nine scientific men, and Pasteur led by 100,000 votes over Victor Hugo, who came second, Napoleon securing the fourth place. It is obvious that a poll of such magnitude must have been representative of all classes. I ask you to reflect on the probable result, *mutatis mutandis,* if such a poll was taken in this country. I am afraid we should find the names of football and cricket heroes included, but I doubt if the name of a single man of science would appear amongst the immortals.

It should be our mission to make evident to the working man his indebtedness to the pioneers of science. Demonstrate to him the close connection between the price of his meat and the use of refrigerating processes founded on the investigations of Joule and Thomson; between the purity of his beer and the labours of Pasteur. Show the collier that his safety is to no small extent due to Humphry Davy; the driver of the electric tramcar that his wages were coined by Faraday. Make the worker in steel realise his obligation to Bessemer and Nasmyth; the telegraphist his indebtedness to Volta and Wheatstone, and the man at the "wireless" station that his employment is due to Hertz. Tell the soldier that the successful extraction of the bullet he received during the South African war was accomplished by the aid of Röntgen. Convince the sailor that his good "landfall" was achieved by the help of mathematicians and astronomers; that Tyndall had much to do with the brilliancy of the lights which warn him of danger, and that to Kelvin he owes the perfection of his compass and sounding line. Impress upon all wage-earners the probability that had it not been for the researches of Lister they, or some member of their family, would not be living to enjoy the fruits of their labours. If we can but bring some 5 per cent. of our voters to believe that their security, their comfort, their health, are the fruits of scientific investigation, then—but not until then—shall we see the attitude of those in authority towards this great question of the encouragement of research change from indifference to enthusiasm and from opposition to support.

When we have educated the man in the street it is possible that we may succeed in the hardest task of all, that of educating our legislators.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—A valuable addition to the equipment of the mining department of the University has been made in the form of an electrically-driven oil-boring derrick, which has been presented by the Oilwell Engineering Company, of Cheadle. The apparatus is capable of boring to a depth of 2000 ft., and by its means mining students will be able to acquire practical experience in the handling of oil-boring plant.

The following appointments have been made:—Mr. L. J. Wills, assistant lecturer in geology and geography; Mr. David Brunt, lecturer in mathematics (to succeed Mr. S. B. McLaren); Dr. C. L. Boulenger, reader in helminthology; Mr. H. G. Jackson, assistant lecturer in zoology.

By the will of the late Henry Follett Osler the University is to receive the sum of 10,000*l*., with a prospective share in the residuary estate.

LEEDS.—The following appointments have been made to the staff of the University:—Mr. S. H. Stelfox, assistant lecturer and demonstrator in engineering; Mr. F. Powis, demonstrator in chemistry; Mr. E. Lee, assistant lecturer in agricultural botany; Mr. N. M. Comber, assistant lecturer in agricultural chemistry; Mr. D. B. Morgans, assistant lecturer and demonstrator in mining.

THE Concrete Institute has arranged a course of six educational lectures on reinforced concrete: its commercial development and practical application, to be given by Mr. H. Kempton Dyson, on Wednesdays in November and December, beginning on November 12. The lectures will be given in the Lecture Hall of the institute, Westminster. There is no fee for the course; admission will be by ticket, obtainable on application from the secretary, the Concrete Institute, Denison House, 296 Vauxhall Bridge Road, Westminster, S.W.

AN examination of the prospectus of the East Ham Technical College, which was opened in 1905, and on which some 33,000*l*. was spent, shows that the boroughs round London are fully alive to the importance of providing a practical training in technology and science for those engaged in the industrial pursuits of the locality. The work of the college is done in some eight departments, and important among these are those for men engaged in building trades, engineers, chemists, commercial men, and for women workers. The more elementary evening classes are held in three preparatory evening schools in different parts of the borough, but in the college itself a preparatory industrial course has been provided designed to enable students later to follow intelligently the lectures and laboratory work in the different departments of technology.

PRESIDING at a recent meeting of the Senate of Calcutta University, Sir Ashutosh Mookerjee made an interesting speech on some of the work of the University. According to a report of the speech given in *The Pioneer Mail*, the University has arranged for lectures for M.A. and M.Sc. students in eleven different branches of study, including pure mathematics and botany. The University has made itself directly responsible for the instruction of 1005 students in Calcutta in these subjects for the M.A. and M.Sc. examinations. Post-graduate teaching on this scale has never before been attempted in any Indian university, and that there is a genuine demand for higher instruction is established by the readiness with which students in large numbers have eagerly joined the classes in such subjects as pure mathematics. The Government of India has made a liberal grant for the acquisition of a site, and plans have been nearly completed for further extension of the University buildings. When the new buildings are erected, there will be ample accommodation for the purposes of instruction, and, it will be possible to accommodate on the premises at least two hundred post-graduate students.

THE calendar for the session 1913-14 of the North of Scotland College of Agriculture has reached us. The classes of the college are held in the University of Aberdeen, except the class in agricultural engineering, which is held in Robert Gordon's Technical College, Aberdeen. The courses of instruction provided are arranged for the benefit of every section of the agricultural community. Persons who can attend the college only for four consecutive weeks in winter will find a short practical course extending over four weeks and including lectures on such subjects as feeding-stuffs, live-stock, diseases of animals, and so on. The full lectures on agriculture and agricultural chemistry extend over three years, but the complete course is modified in a variety of ways to meet particular needs and to enable students to secure the college diploma or the national diploma in agriculture. There is a special department of forestry, and for practical work, through the liberality of several landed proprietors, excellent facilities are afforded. The close proximity to Aberdeen of large wooded areas places it in an advantageous position for the teaching of forestry. Farmers residing within the college area are entitled to receive advice and assistance from members of the college staff free of charge. There is, also, a carefully arranged scheme of county extension work under the superintendence of a general county organiser.

THE calendar of the University of Sheffield for the session 1913-14, a copy of which has been received, provides striking evidence of the successful efforts which provincial universities are making to keep in close touch with the varied actvities of the districts they serve. Not only does the University of Sheffield train students who desire to follow the usual academic courses which culminate in degrees in arts, pure science, medicine, law, and so on, but it provides also graduated instruction in such applied sciences as engineering, metallurgy, and mining, and awards degrees in these branches of technology to students who at the end of the training comply with the reasonable regulations specified in the calendar. To meet the special needs of students whose circumstances make it impossible for them to devote the time necessary for complying with the conditions for degrees, associateship and diploma courses have been arranged. The mining department of the University carries out a system of extension lectures in technical science in the West Riding of Yorkshire; a works pupils' certificate course has been arranged by the University in consultation with the Sheffield Master Builders' Association to meet the requirements of students who are working with the object of becoming master builders; a diploma course in domestic science has been inaugurated; and in other ways the University is assisting the higher education of Sheffield workers.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 13.—M. F. Guyon in the chair.—Paul **Marchal**: The acclimatisation of *Novius cardinalis* in France. In 1912 *Icerya purchasi* was accidentally introduced into France, at Cap Ferrat, and caused great damage. This plant pest has been successfully fought in California and elsewhere by the introduction of its natural enemy, *Novius cardinalis*, and steps were taken to acclimatise this at Cap Ferrat. The results were completely successful, the Icerya being rapidly exterminated.—Charles **Depéret**: The fluvial and glacial history of the Rhône valley in the neighbourhood of Lyons. Evidence is given that there were three glacial invasions of this region and not two, as currently held, leading to the formation of three fluvio-glacial terraces.—Leopold **Fejér**: Trigonometric polynomials.—Michel **Fekete**: A property of the roots of the arithmetical means of a real integral series.—N. **Gunther**: The cononical form of algebraical equations.—M. **Tomassetti** and J. S. **Zarlatti**: The problem of two bodies of variable masses.—Thadée **Peczalski**: Relations between the coefficients of expansion and the thermodynamical coefficients.—France **Giraud**: Certain reactions depending on reply currents.—R. **Dongier** and C. E. **Brazier**: The sound effect produced at the contact of a metallic point and the surface of a crystal or a metal by the passage of an alternating current. A faint musical note was first noted in a galena detector at the Eiffel Tower. Means have been found to reinforce this note so that wireless signals can be heard at a distance of 22 metres from the apparatus.—Ch. **Gravier**: An automatic method of developing photographic plates. —B. A. **Dima**: The photo-electric effect of metallic compounds. The photo-electric effect of analogous compounds of the same metal depends on the valency of the metal in those compounds. The four oxides of manganese offer a clear example of this.—Yugi **Shibata** and G. **Urbain**: The spectrochemistry of the complex cobalt compounds. A study of the absorption bands in the visible and ultra-violet spectra of solutions of complex cobalt salts.—M. **Taffanel** and Le **Floch**: The combustion of gaseous mixtures. Mixtures of methane and air were heated to various temperatures between 535° C. and 640° C., and the rates of combustion measured. These results are extrapolated to evaluate the inflammation temperatures of these mixtures.—P. **Lemoult**: Leucobases and colouring matters of diphenylethylene. The first stage of oxidation of the *cyclo*hexylidenic leucobase,

$$E.H_{10}.=C.[EH_4N(CH_3)_2]_2.$$

Tetrahydro-malachite green.—C. **Gerber** and P. **Flourens**: The trypsin of *Calotropis procera* and the poison which accompanies it. The latex contains a proteolytic ferment very resistant to heat, and most active in alkaline or neutral media. It coagulates milk and digests casein and fibrin. Injected subcutaneously it is rapidly fatal to some animals (guinea-pig, pigeon), whilst in others it produces only local troubles (white rat, rabbit). Separation of the trypsin and the toxic substance has not been effected.—A. **Gouvel**: The genus Palinurus in Madagascar.—A. **Brachet**: The inhibiting action of the sperm of *Sabellaria alveolata* on the formation of the membrane of fertilisation of the egg of *Paracentrotus lividus*.—A. **Paillot**: Parasitic coccobacilli of insects.—Sabba **Stefanescu**: The structure of the crown of the elephant's molars.—Michel **Longchambon**: The breccia of the marmorean complex: conclusions which may be drawn concerning the age and the localisation of lherzolite.—François **Picavet**: The commemoration of Roger Bacon in 1914. It is proposed to publish a complete edition of Roger Bacon's works.

CAPE TOWN.

Royal Society of South Africa, September 17.—The president in the chair. W. A. **Jolly**: The interpretation of the electrocardiogram. The interpretation of the electrocardiogram has remained doubtful, notwithstanding the large amount of work that has been devoted to it in recent years, and very divergent views are entertained as to the significance of the various features of the curve without conclusive evidence having been adduced for them. The author gives an explanation arrived at from experiments on the isolated tortoise heart, and especially from cases of systolic alternation in auricles and ventricle.—Paul A. **Methuen** and John **Hewitt**: A contribution to our knowledge of the anatomy of the chameleon. After making a comparative examination of the lungs, sternum, and skull in various members of the family the authors conclude that the most generalised and probably most primitive forms are the genera Brookesia and Rhampholeon (the latter not actually examined by the authors), whilst the viviparous small chameleons of the pumilus group, so characteristic of South Africa, are the most primitive in the genus Chameleons: for these latter species, pumilus and allies, the authors revive the old generic name Lophosaura of Gray. It appears probable that the family, as we know it to-day, has spread from a centre of origin situated in that portion of the Ethiopian region of which there now remains two separated components, Madagascar and the Cape province of Sclater. There is no evidence in favour of a northern origin for this family.—R. **Marloth**: Note on the Pollination of *Encephalartos altensteinii* (Kaffir bread tree). The insect on which the transport of the pollen from the male cone to the female cone of *Encephalartos altensteinii* and *E. villosus* depends is not a Phlœophagus, as stated in a paper recently published in the Transactions of the Royal Society, S.A., but *Antliarrhinus zamiae*, that means the same insect which lives in the seeds of these plants until the cones disintegrate and enable the mature insect to escape from them. The female insect pollinates the ovules while moving about between them for the purpose of depositing its eggs. Although according to Dr. Rattray's observations, some or most, or even sometimes all, the seeds of a cone are thus destroyed by the grubs of the insect, the visits of the insect are nevertheless essential to the plant, for without them no seeds would be formed at all. The case is quite parallel to that of the Yucca moth (Pronuba), which, while depositing its eggs into the pistil of the Yucca, pollinates the flower.

Göttingen.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part 3 for 1913, contains the following memoirs communicated to the society:—

July 20, 1912.—A. **Ansel**: Seismic records at Göttingen during 1911 (with seven figures and a table, illustrating the graphical solution of spherical triangles).

March 8, 1913.—L. **Geiger**: Seismic records at Göttingen during 1909.

May 24.—G. **Pólya**: Approximation by means of polynomials, all the roots of which fall within an angular sector.—R. **Fueter**: A property of the *Klassenkörper* of complex multiplication.—G. **Tammann**: The melting point.—O. **Mügge**: Filiform crystals of green vitriol and silver.—L. **Godeaux**: Cyclic involutions of order 2α and genus 1 on a surface of genus 1.

July 5.—R. W. **Hoffmann**: The embryonic development of the Strepsiptera (preliminary communication, with figures).

July 19.—D. **Hilbert**: Remarks on the foundation of an elementary theory of radiation.—O. **Toeplitz**: A problem, connected with Dirichlet-series, in the theory of series of powers of an infinite number of variables.

The business communications (part 1 for 1913) include reports by H. **Wagner** on the Samoa Observatory for 1912–13, and by F. **Klein** on the progress of the publication of Gauss's works.

BOOKS RECEIVED.

Studies in Cancer and Allied Subjects. Vol. i., The Study of Experimental Cancer. A Review. By Dr. W. H. Woglom. Pp. xi+288+plates. Vol. iii., From the Department of Zoology, Surgery, Clinical Pathology, and Biological Chemistry. Pp. ix+308. (New York: Columbia University Press.) Each 5 dollars net.

A Geography of the British Empire. By W. L. Bunting and H. L. Collen. Pp. iv+159. (Cambridge University Press.) 3s. 6d.

Early Wars of Wessex. By A. F. Major. Edited by the late C. W. Whistler. Pp. xvi+238. (Cambridge University Press.) 10s. 6d. net.

Weeds: Simple Lessons for Children. By R. L. Praeger. Pp. x+108+iii plates. (Cambridge University Press.) 1s. 6d. net.

The Freezing-Point Lowering, Conductivity, and Viscosity of Solutions of certain Electrolytes in Water, Methyl Alcohol, Ethyl Alcohol, Acetone, and Glycerol, and in Mixtures of these Solvents with one another. By H. C. Jones and collaborators. Pp. vii+214. (Washington, D.C.: Carnegie Institution.) 2 dollars.

The Wonders of Wireless Telegraphy. By Prof. J. A. Fleming. Pp. xi+279. (London: S.P.C.K.) 3s. 6d. net.

A Text-book of General Embryology. By Prof. W. E. Kellicott. Pp. v+376. (New York: H. Holt and Co.) 2.50 dollars.

Industrial and Commercial Geography. By Prof. J. R. Smith. Pp. xi+914. (New York: H. Holt and Co.) 3.50 dollars.

Die Atomionen chemischer Elemente und ihre Kanalstrahlen-Spektra. By Dr. J. Stark. Pp. 43. (Berlin: J. Springer.) 1.60 marks.

Zur Krise der Lichtäther-Hypothese. By Prof. P. Ehrenfest. Pp. 23. (Berlin: J. Springer.) 60 pfennigs.

Die Europaeischen Schlangen. By Dr. F. Steinheil. Drittes Heft. Plates 11 to 15. (Jena: G. Fischer.) 3 marks.

Mendelism and the Problem of Mental Defect. I., A Criticism of Recent American Work. By Dr. D. Heron. Pp. 62. (London: Dulau and Co., Ltd.) 2s. net.

The Shetland Pony. By C. and A. Douglas. With an Appendix on the Making of the Shetland Pony, by Prof. J. Cossar Ewart. Pp. xi+176+plates. (Edinburgh and London: W. Blackwood and Sons.) 10s. 6d. net.

The Sugars and their Simple Derivatives. By Dr. J. E. Mackenzie. Pp. xvi+242. (London: Gurney and Jackson.) 7s. 6d. net.

The Absorption Spectra of Solutions as affected by Temperature and by Dilution. By H. C. Jones and J. S. Guy. Pp. vii+93+22 plates. (Washington: Carnegie Institution.) 2 dollars.

Reversion in Guinea Pigs and its Explanation. By W. E. Castle. Experimental Studies of the Inheritance of Color in Mice. By C. C. Little. Pp. 102+5 plates. (Washington: Carnegie Institution.)

A First Book of Nature Study. By E. Stenhouse. Pp. iv+148. (London: Macmillan and Co., Ltd.) 1s. 6d.

Die Grundlagen der Naturphilosophie. By Dr. H. Dingler. Pp. x+262. (Leipzig: Unesma G.m.b.H.) 6 marks.

Fortschritte der Naturwissenschaftlichen Forschung. Edited by Prof. E. Abderhalden. Neunter Band. Pp. 280. (Berlin and Vienna: Urban and Schwarzenberg.) 15 marks.

Objektive Psychologie oder Psychoreflexologie die Lehre von den Assoziationsreflexen. By Prof. W.

von Bechterew. Pp. viii + 468. (Leipzig and Berlin: B. G. Teubner.) 16 marks.

Physikalisches über Raum und Zeit. By E. Cohn. Zweite Auflage. Pp. 24. (Leipzig and Berlin: B. G. Teubner.) 80 pfennigs.

Das Relativitätsprinzip. By H. A. Lorentz, A. Einstein, and H. Minkowski. Pp. 89. (Leipzig and Berlin: B. G. Teubner.) 3 marks.

The Silicates in Chemistry and Commerce. By Drs. W. and D. Asch. Translated, with Critical Notes and some Additions, by A. B. Searle. Pp. xx + 456. (London: Constable and Co., Ltd.) 21*s.* net.

The Respective Standpoints of Psychology and Logic. By M. Castro. Pp. 77. (Chicago: University of Chicago Press; Cambridge University Press.) 2*s.* net.

Canada. Department of Mines. Mines Branch. Economic Minerals and Mining Industries of Canada. By the Staff of the Mines Branch. Pp. 77 + xix plates. (Ottawa: Government Printing Bureau.)

Problems of Genetics. By W. Bateson. Pp. ix + 258. (Oxford University Press.) 17*s.* net.

University College, Reading. Studies in History and Archæology: Black Glaze Pottery from Rhitsona in Boeotia. By Prof. P. N. Ure. Pp. 63 + xix plates. (Oxford University Press.) 7*s.* 6*d.* net.

Insect Biographies with Pen and Camera. By J. J. Ward. Pp. xii + 206 + plates. (London: Jarrold and Sons.) 6*s.* net.

Die Elemente der siebenten Gruppe des periodischen Systems. Aus Abegg's Handbuch der anorganischen Chemie. Vierter Band. Zweite Abteilung. Edited by Dr. F. Auerbach. Pp. x + 904. (Leipzig: S. Hirzel.) 26 marks.

Zellen- und Gewebelehre Morphologie und Entwicklungsgeschichte. I., Botanischer Teil. By E. Strasburger and W. Benecke. Pp. vi + 338. II., Zoologischer Teil. By R. Hertwig, H. Poll, O. Hertwig, and others. Pp. vi + 538. (Leipzig and Berlin: B. G. Teubner.) 10 marks and 16 marks respectively.

Biochemie der Pflanzen. By Dr. F. Czapek. Zweite Auflage. Erster Band. Pp. xix + 828. Jena: G. Fischer.) 24 marks.

Flies in Relation to Disease. Non-Bloodsucking Flies. By Dr. G. S. Graham-Smith. Pp. xiv + 292 + xxiv plates. (Cambridge University Press.) 10*s.* 6*d.* net.

The English Year. By W. B. Thomas and A. K. Collet. Pp. viii + 408 + plates. (London and Edinburgh: T. C. and E. C. Jack.) 10*s.* 6*d.* net.

Industrial Organic Analysis. By P. S. Arup. Pp. xii + 340. (London: J. and A. Churchill.) 7*s.* 6*d.* net.

Sleeping Sickness in the Island of Principe. By Surgeon-Captain B. F. Bruto da Costa. Translated by Lieut.-Col. J. A. Wyllie. Pp. viii + 90. (London: Ballière, Tindall and Cox.) 2*s.* 6*d.* net.

Handworterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 60 and 61. (Jena: G. Fischer.) Each 2.50 marks.

The Meaning of Evolution. By Prof. S. C. Schmucker. Pp. 298. (London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

The Montessori Principles and Practice. By Prof. E. P. Culverwell. Pp. xvii + 309. (London: G. Bell and Sons, Ltd.) 3*s.* 6*d.* net.

The London University Guide, 1914. Pp. xxii + 227. (London: University Correspondence College.)

DIARY OF SOCIETIES.

THURSDAY, October 23.

Institution of Civil Engineers, at 9.—Progress of Marine Construction: Alex. Gracie.

FRIDAY, October 24.

Institution of Mechanical Engineers, at 8.—Modern Flour Milling Machinery: R. B. Creak.

Physical Society, at 5.—The Ice Calorimeter: E. Griffiths.—An Electrostatic Oscillograph: H. Ho and S. Kotô.

Junior Institution of Engineers, at 8.—Mechanical Advertising and Similar Appliances: H. W. Sewell.

TUESDAY, October 28.

Zoological Society, at 8.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. XI. A New Genus of Tapeworms from Œdicnemus: F. E. Beddard.—The Fossil Crinoids referred to Hypocrinus, Beyrich: F. A. Bather.—*Batrachiderpeton lineatum*, Hancock and Atthey, a Coal Measure Stegocephalian: D. M. S. Watson.—The Brain and Brain-case of a Fossil Ungulate of the Genus Anoplotherium: R. W. Palmer.

WEDNESDAY, October 29.

British Astronomical Association, at 5.—Presidential Address.

FRIDAY, October 31.

Junior Institution of Engineers, at 8.—The Difference between a Drain and a Sewer: R. Kelsey Jones.

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*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

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THURSDAY, OCTOBER 30, 1913.

RADIATION THEORIES.

Vorlesungen über die Theorie der Wärmestrahlung. By Dr. Max Planck. Zweite Auflage. Pp. xii+206. (Leipzig: J. A. Barth, 1913.) Price 7 marks.

THE first edition of this book, which appeared in 1906, was reviewed in NATURE (October 11, 1906, Supplement iii.). The many and varied contributions to our knowledge of radiation phenomena that have been published in the ensuing seven years have made it necessary for Dr. Planck to rewrite and modify the book to a considerable extent, so that it now contains many novel features. As before, the object of the book is to apply the statistical methods previously used in the kinetic theory of gases to the phenomena of radiation, and full use is made of Boltzmann's views on the interpretation of entropy in connection with the theory of probability. But the present treatment is largely based on the remarkable assumption which the author designates as the "quantum-hypothesis."

The property thus assumed for the elementary electrical oscillators under consideration may perhaps best be explained by comparing them to the cisterns, of which many have been invented and which are so arranged that when the water in them reaches a certain level they overturn and empty themselves, then returning to their original position to be refilled. In other words, absorption takes place continuously, while emission occurs intermittently when the energy of the oscillator attains one or other of certain discrete values. This "quantum hypothesis," as the author points out, is analogous to the electron theory, which assigns a definite magnitude to the electron or "elementary quantum" of electricity. It accounts for Nernst's observed phenomena, and, further, it is in accordance with the view that every different radiation corresponds to a certain definite temperature, and it is already beginning to form an important element in present-day physical researches.

It need scarcely be pointed out that the quantum hypothesis entails irreversibility and thus overcomes a difficulty of the kinetic theory of gases, namely, that even statistical methods apparently fail to account for irreversible phenomena when applied to a system the elements of which are subject to the equations of reversible dynamics, unless some further assumption is made ("Assumption A" of the late Mr. Burbury). It will thus be seen that the present method does not pretend to afford a so-called "dynamical proof" of the phenomena of radiation, and in the preface Dr. Planck distinctly expresses the view that a new principle cannot in general be represented by a model working according to old laws. It will also be evident that brief indications of the new method, such as those contained in this notice, cannot be regarded as adequate descriptions of the real substance of Dr. Planck's investigations.

It was natural that a theory fraught with such far-reaching consequences should attract considerable attention at the recent meeting of the British Association, and the occasion was the more suitable as the presidency of Sir Oliver Lodge had attracted to the meeting a number of physicists all keenly interested in radiation theories. It would be undesirable to refer in greater length to these discussions, as they will be dealt with elsewhere. A popular account of modern radiation theories, including special reference to Dr. Plancks quantum hypothesis, was given by Dr. Max Born, of Gottingen, in *Die Naturwissenschaften* 21, for May 28, p. 499.

It does not appear to the present reviewer that the quantum hypothesis is necessarily irreconcilable with dynamical principles. If we take the equations of motion of a dynamical system and write down the expressions for the second differential coefficients of the squares and products of its velocities, we obtain formulæ which may be said to determine the energy accelerations of the system in the same way that the ordinary equations of motion determine the accelerations of the masses. If we assume conditions of statistical equilibrium we find a definite amount of energy associated with a definite system, and we further find that certain conditions must hold in order that energy equilibrium may be possible. Such a method establishes a kind of principle of duality between the properties of matter and the properties of energy, and is distinctly favourable to an atomic theory of energy. But the attempt to reduce everything to dynamics would of course land us in the old difficulty over the irreversibility.

G. H. B.

CHEMICAL TEXT-BOOKS.

(1) *Osmotic Pressure.* By Prof. A. Findlay. Pp. vi+84. (London: Longmans, Green & Co., 1913.) Price 2s. 6d. net.

(2) *The Organometallic Compounds of Zinc and Magnesium.* By Dr. Henry Wren. Pp. viii+100. (London: Gurney and Jackson, 1913.) Price 1s. 6d. net.

(3) *The Chemistry of Dyeing.* By Dr. J. K. Wood. Pp. vii+80. (London: Gurney and Jackson, 1913.) Price 1s. 6d. net.

(4) *V. v. Richter's Chemie der Kohlenstoffverbindungen oder organische Chemie.* Elfte Auflage. Zweiter Band. Carbocyclische und heterocyclische Verbindungen. Neu bearbeitet von Dr. Richard Anschutz. In Gemeinschaft mit Dr. Hans Meerwein. Pp xxii+1048. (Bonn: Friedrich Cohen, 1913.) Price 26 marks.

(5) *Traité Complet d'Analyse Chimique Appliquée aux Essais Industriels.* By Prof. J. Post and Prof. B. Neumann. Deuxième Edition Française Entièrement Refondue par G. Chenu et M. Pellet. Tome Troisième. Second Fascicule. Pp. 465-903+v. (Paris: A. Hermann et Fils, 1913.) Price 15 francs.

(6) *Traité de Chimie Minérale.* By H. Erdmann. Ouvrage traduit sur la 5e édition allemande par Prof. A. Corvisy. Tome Premier. Introduction à la Chimie et Métalloïdes. Pp. iv+559. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

(7) *Laboratory Text-Book of Chemistry.* By V. Seymour Bryant. Part I. Pp. vi+246. (London: J. and A. Churchill, 1913.) Price 4*s.* net.

(1) THOSE who have read Dr. Findlay's book on the phase rule will have formed great expectations of his promised monograph on osmotic pressure, and we believe they will not be disappointed. The expression osmotic pressure of a solution has become a familiar one both to chemists and biologists, though, as Dr. Findlay is careful to point out, it is incorrect. A solution does not in itself have any osmotic pressure, the term being loosely used to denote the mechanical pressure *which would be produced* if the solution were separated from the pure solvent by a membrane which was permeable only to the solvent. The confusion of thought which has arisen in connection with the subject, especially amongst the biologists, is unfortunately very considerable, so that Dr. Findlay's clear treatise comes at an opportune moment and should be widely read. Although necessarily mathematical in parts, it is not unduly so, even for the biological reader.

The author shows himself to be no bigot in favour of the extreme views of the German physical-chemical school, and his chapter on the cause of osmosis and the action of the semipermeable membrane reaches a high standard. Regarded from the biological side, the subject of osmosis is one in which we are on the eve of important developments requiring interpretation in the broadest possible manner. In the past the tendency has been to give too little attention to the chemical meaning of the osmotic phenomena, but this error is avoided in the present work.

The work of Lord Berkeley in this country and that by Morse in America is described at length and its bearing on the general theory of ideal solutions discussed in a separate chapter. Emphasis is laid on the thermodynamic equation connecting the osmotic pressure with the vapour pressure of solutions.

(2), (3) Chemical monographs are evidently fashionable, and the success of the biochemical series edited by Dr. Plimmer and the inorganic series for which Dr. Findlay is responsible has inspired others to imitate them. The new series for which Dr. Cumming is sponsor are, however, of a different type and can scarcely lay claim to the title monograph—indeed, the use of the term is misleading. They are essentially summaries intended for advanced students with the examination bugbear in front of them, and though no doubt they will be very useful, they are in no way authoritative in the same sense as the other monographs to which reference has been made. However, they are well printed and convenient in size and price, and should prove very popular among students.

No. 1 in the series is Dr. Wren's essay on the organometallic compounds of zinc and magnesium. Though Grignard described the reaction which now bears his name so recently as 1900, the method has proved so fruitful in effecting organic syntheses that their number is already legion, and the subject forms, we fear, a very favourite examination question—hence, no doubt, the motive and form of the present summary. The mode of using the reagent is first described, but the bulk of the book is devoted to the description, with copious formulæ, of the products formed by its aid. A few pages are devoted to the theory of the reaction. The final section deals with Blaise's more recent applications of the organometallic derivatives of zinc, which afford reagents of less general activity and of greater ease of control.

Dr. Wood's summary of the chemistry of dyeing is simply and clearly written and devoid of technical terms, so that it should appeal to a wider public than the chemical student and, indeed, be in the hands of all practical dyers. The scheme followed is first to discuss the chemical composition and properties of the textile fibres, then to deal with the classification and properties of dyes, and lastly with the nature of the dyeing processes. A small bibliography and index is attached. The author is to be congratulated on the clear way in which he has dealt with the rival theories of dyeing within a short space.

(4) A new edition of Richter scarcely calls for criticism beyond the statement that the authors have maintained the standard of a work which has been indispensable to all students of organic

chemistry in the past and is likely to prove equally valuable to all in the future. No other text-book is so exhaustive and yet relatively still readable. We have taken the opportunity to test it somewhat severely and always found the desired information. The new edition does, however, afford an opportunity of noting the enormous increase in our knowledge of this part of organic chemistry—embracing the carbocyclic and heterocyclic compounds. Our former copy of the ninth edition, bearing the date 1901, is a modest little work of 809 pages, measuring 4 × 6 inches. The new edition requires 1048 pages, measuring $4\frac{1}{2} \times 7$ inches.

Even in 1900 the would-be chemist made some attempt to master the whole of Richter—to-day this is obviously impossible, and the student is forced to specialise at an early stage in his reading. Fortunately, chemical literature is now enriched by very many special monographs of a very readable character and free from too much elaboration of detail. When these are supplemented by Richter—the encyclopædia of chemistry—the student is indeed well armed. We have one suggestion only—namely, the author's name, as well as the journal reference, should be quoted in the references to the original literature. The omission of the author's name prevents reference to the abstracts of the original in the Journal of the Chemical Society or in the *Centralblatt* when the original paper itself is not available.

(5), (6) These translations of well-known standard German works testify to the rank taken by German science in other lands: they are already well known in this country. The second part of vol. iii. of Prof. Neumann's technical analysis contains Schultz's famous monograph on coal tar and artificial colouring matters, which already has a world-wide reputation and forms an appropriate complement to Germany's most famous chemical industry. This is the second French edition translated from the third German edition of the work.

Prof. Corvisy's book is a translation for the first time of the fifth German edition of the first volume of Erdmann's well-known work. The translator refers to the need of such a work in France, where no other book is available for students covering the ground in quite the same way.

(7) This book is intended to be actually used as a laboratory note-book in schools, the pupil having to write his answers in the spaces in the text left for the purpose. Precise instructions are given how to do everything and what to observe and infer, and in quantitative exercises only the actual figures have to be filled in by the schoolboy. The book is elaborately bound and somewhat expensive. We fear we do not agree with the author's interpretation of practical chemistry; indeed, we had hoped that books of this type had ceased to exist.

E. F. A.

PROBLEMS OF LIFE AND REALITY.

(1) *Essais de Synthèse Scientifique.* By E. Rignano. Pp. xxi + 294. (Paris: F. Alcan, 1912.) Price 5 francs.

(2) *Contre la Métaphysique.* By F. Le Dantec. Pp. 255. (Paris: F. Alcan, 1912.) Price 3 francs 75 centimes.

(3) *Modern Science and the Illusions of Prof. Bergson.* By H. S. R. Elliot. With a preface by Sir Ray Lankester, K.C.B., F.R.S. Pp. xix + 257. (London: Longmans, Green and Co., 1912.) Price 5*s.* net.

(4) *Wissenschaft und Wirklichkeit.* By Max Frischeisen-Köhler. Pp. viii + 478. (Berlin: B. G. Teubner, 1912.) Price 8 marks.

(5) *The Young Nietzsche.* By Frau Förster-Nietzsche. Translated by A. M. Ludovici. Pp. viii + 399. (London: W. Heinemann, 1912.) Price 15*s.* net.

THE first two of these volumes contain a curiously similar plea for the theorist in science. M. Rignano in his opening essay (1) maintains that there are a number of central problems in the biological sciences, in which there is almost a deadlock, due to the fact that they have been attacked exclusively by two opposite groups of specialists. One such problem, awaiting the synthetic view, is that of the nature of life and growth. Others are: the meaning of religion as viewed from the psychological and the sociological points of view; the economic and ideologic factors in history; the antithesis of socialism and liberal economics. These are dealt with in successive essays. In the first the various transformist theories are reviewed, in order to demonstrate how far-reaching may be the clarifying effects of a single piece of theorising. At the same time the *leit-motiv* of the whole volume is introduced—the mnemonic principle. The recapitulation of phylogenetic development in ontogenesis is essentially mnemonic, as is assimilation.

The same principle is next applied more in detail to the problem of growth, by means of a summary of the author's "centro-epigenetic" theory of development. This asserts that growth is determined by a nervous circulation, independent of a nervous system, consisting of discharges of specific nervous energy accumulated in the germ-plasm, each discharge depositing a substance apt in decomposing to regenerate the same specific nervous current. "Memory" in this wide sense is next applied to explain the affective tendencies (conations) which are regarded as strivings to regain physiological equilibrium. Thus one and the same explanation holds of all the finalism of life, namely, the mnemonic property of vital substance, that faculty of "specific accumulation" which belongs exclusively to nervous energy, itself the basis of life. The other essays reveal the same acuteness, fertility, and confidence in theorising.

(2) M. le Dantec, after a semi-serious demonstration that the philosopher is an artist, to be appreciated by those vibrating in harmony with him rather than understood by mankind at large, and a plea for more reasoning in natural science and less "kitchen-technique," proceeds also to consider the central problems of biology. All vital phenomena fall under the head of "functional assimilation." The organism assimilates *qua* organ of its function at the moment. Thus a mammal into whose peritoneum cow's milk is injected assimilates this, if it survives, *qua* organ of the struggle against cow's milk, but not absolutely, for it retains a trace or "memory" (cf. Rignano) in that its serum will henceforth give a precipitate with cow's milk. Thus it is impossible to separate "nature" and "nurture," though the part played by the latter must be relatively small "on pain of death." Like M. Rignano, a Neo-Lamarckian, M. le Dantec holds that among the transmissible acquisitions are the instincts, and logic, "the *résumé* of ancestral experience."

(3) Mr. Elliot's view of philosophy is, broadly, that it consists in making unfounded and untestable statements about the universe—mapping the back of the moon. Now this is surely a mistake; philosophy is not description, but explanation; and to explain is to bring unconnected or conflicting facts under one general law or notion. Sometimes it is merely a question of selecting the right familiar notion, but often a *new* "appropriate conception" has to be created, a process the difficulty and importance of which Mill so greatly underestimated; and philosophical explanation is evidently likely to be of this nature.

Thus while it is legitimate criticism of a philosophy to say that it is incomprehensible (a line pretty effectively worked by Schopenhauer) it is unreasonable to insist that it must be easily comprehensible, or use only everyday notions. Nor can one fairly complain if philosophers do not adduce specific facts for their theories. Negative evidence can disprove an explanatory hypothesis; positive evidence can only "verify" it cumulatively, and here the facts are broadly not in dispute. This, if correct, invalidates much that Mr. Elliot says about M. Bergson's "besetting fallacies," *e.g.*, the "mannikin fallacy." Again, his keen scent for "false analogy" often leads Mr. Elliot to take as demonstration what is clearly meant as "explication." While always acute and often touching on real difficulties, Mr. Elliot too often allows himself to be tempted, in sporting parlance, into smashes which find the net.

(4) Perhaps the least of the differences between the last work and Herr Frischeisen-Köhler's essay in critical realism is that in the latter M. Bergson is not so much as mentioned. The nineteenth century saw a movement of opposition to the intellectualism of the seventeenth and eighteenth centuries, and the book aims at helping to find a common point of view for the sciences typical of the two points of view—mathematics and history, the latter of which can never be based on pure thought. The method is a critical consideration of the conditions involved in consciousness, which themselves contain the bases of knowledge. Of the categories or modes of experiencing involved in consciousness, however, only that of reality is considered.

The closely-reasoned exposition is impossible to summarise here, but it involves the discussion of the two main modern attempts to derive all experience from the laws of pure thought—the logical idealism of the Marburg school and the philosophy of values developed by Windelband and Rickert. Finally, the empirical bases of our notion of reality are found, above all, in experiences of striving and resistance. Like fish in a glass bowl we are unable to go further in some directions, and since this experience always occurs in conjunction with certain sense-impressions, we recognise in these that which sets limits to our subjectivity. The real remains, indeed, always within the conditions of consciousness in general, but within consciousness the independence of the objective world from the self is assured. The book is a clearly-written, cautious, and eminently helpful discussion of the difficult problems with which it deals.

(5) Having nothing in common with the other works except that it deals with a philosopher, the life of Nietzsche by his sister is an interesting and pleasing account of the first happy portion of that tragic existence. Strangely unlike a morose apostle of hardness is the almost painfully well-behaved child in the country parsonage, the brilliant schoolboy with all the German idealism and *schwärmerei*, the student shocked by the coarseness of university conviviality, the youthful professor of classics, the heroic but too sensitive ambulance volunteer in the Franco-Prussian war. The book takes us to the end of the friendship

with the Wagners, and it is its main weakness that it fails to make clear the reason either for the intensity or for the abrupt end of this devotion. The translation is quite satisfactory, and some excellent portraits add much to the book's effectiveness.

TEXT-BOOKS ON HEAT AND THERMODYNAMICS.

(1) *An Introduction to the Mathematical Theory of Heat Conduction.* With engineering and geological applications. By Prof. L. R. Ingersoll and O. J. Zobel. Pp. vi+171. (London and Boston: Ginn and Co., n.d.) Price 7*s.* 6*d.*

(2) *The Laws of Thermodynamics.* By W. H. Macaulay. Pp. viii+71. (Cambridge: University Press, 1913.) Price 3*s.* net.

(3) *A Text-book of Thermodynamics (with special reference to Chemistry).* By J. R. Partington. Pp. viii+544. (London: Constable and Co., Ltd., 1913.) Price 14*s.* net.

(4) *Lehrbuch der Thermodynamik.* Nach Vorlesungen von Dr. J. D. v. d. Waals. Bearbeitet von Dr. Ph. Kohnstamm. Zweiter Teil. Pp. xvi+646. (Leipzig: J. A. Barth, 1912.) Price 12 marks.

(5) *Leçons de Thermodynamique.* By Dr. Max Planck. Avec une conference du même à la Société chimique de Berlin sur Le Théorème de Nernst et L'Hypothèse des Quante. Ouvrage traduit sur la troisième édition allemande (augmentée). By R. Chevassus. Pp. 310. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

(1) THIS book is the outcome of the authors' teaching experience, and as one might expect, covers the ground usually required for a university degree. The subject-matter includes the Fourier equation, the steady flow of heat in one and more than one dimension, periodic flow in one dimension, Fourier's series applied to the linear flow of heat in the case of an infinite as well as semi-infinite solid, heat sources, slab and radiating rod, and in addition radial flow, instantaneous heat source at a point, sphere with surface at constant temperature, sphere cooled by radiation, and the general case of heat flow in an infinite medium. The concluding chapter deals with the formation of ice. The appendix contains a list of values for the thermal conductivities and emissivity factors, as well as the more commonly occurring integrals and miscellaneous formulæ. The striking feature about the book is the prominence which is given to the experimental applications of the expressions derived. These belong mainly to engineering, though the student of pure physics will find many of them of considerable interest. At the end of each chapter there are a number of problems to be worked out. As the work covers a relatively large field the authors have had to restrict themselves to typical cases. Full references are given, however, on particular points to larger works and original papers. The authors have compiled a very useful text-book of moderate size, which should appeal to a fairly wide circle of readers.

(2) This monograph contains a succinct account of the fundamental principles of thermodynamics. The writer has been singularly happy in combining precision and accuracy of statement with remarkable lucidity and readableness. Although he warns us in the preface that the tract should be read "in conjunction with other information," it ought to be found by no means beyond the grasp of the beginner. The subject is presented, in the first instance, from the engineer's point of view, though the nature of the publication is such as to preclude any very detailed illustrations of an applied character. This has the advantage, however, of making the work more interesting to the general reader. The author commences by explaining perfect differentials, and then passes on to the first and second laws and the four thermodynamic relations. In addition to the perfect gas, considerable space is devoted to the treatment of wet and dry steam, and a short account of the lead accumulator. The monograph as a whole forms a very excellent introduction to engineering thermodynamics.

(3) The first sixteen chapters of Mr. Partington's "Thermodynamics" represent a very full and detailed account of the classical theory along the usual lines. The two final chapters of the book deal rather briefly—considering the growing importance of the subject—with Nernst's heat theorem and the theory of energy quanta. The reader is assumed to be fairly well equipped as far as mathematics is concerned, and for chemists, at any rate, the book will in places make fairly severe reading. All the thermodynamic potentials (Gibbs' μ included) are freely employed, as well as the cycle method. Perhaps the least satisfactory is the chapter on electrochemistry. An English book dealing with thermodynamics from the chemical point of view is rather badly wanted, however, and Mr. Partington's deserves to meet with a good reception.

(4) As anyone familiar with van der Waals' writings will anticipate, the present work is by no means a text-book of thermodynamics in the ordinary sense of the term. This second volume, like the first (which appeared in 1908), is based upon Prof. van der Waals' lectures, the material being edited for the Press by Prof. Kohnstamm. As the sub-title expressly states, this volume deals

with the application of thermodynamics to liquid-gaseous systems containing more than one component. Although the phase rule and the theory of dilute solutions (from the osmotic point of view) are discussed at some length, the greater part deals with the problems of phase equilibrium from the points of view and by the methods with which one associates the name of van der Waals himself. The book is divided into two main parts, first, the consideration of systems in the absence of external forces, chemical or capillary effects, and secondly, the behaviour of systems when exposed to such forces. The work requires no introduction to English readers. The fundamental nature of the subject itself, and the fact that it emanates from the greatest living authority upon this subject, ought to provide a sufficient reason for every physicist and physical chemist becoming acquainted with it.

(5) Planck's thermodynamics is already so well known to readers in every country that it is only necessary in this place to direct attention to the appearance of the (enlarged) French translation of the third German edition. It would be utterly futile to attempt any worthy review of this book in the space of a few lines. A very interesting feature of this edition is the incorporation by the French translator of the lecture on Nernst's theorem and the energy quanta hypothesis delivered by Prof. Planck in December, 1911, before the German Chemical Society, and also a list of the papers on thermodynamics published by Prof. Planck with cross-references to the paragraphs of the book in which the same subjects are treated. The work is divided into four parts: the first deals with fundamental experiments and definitions, the second and third with the first and second laws, whilst the concluding part takes up the application of those laws to special physical chemical cases. The last chapter of this part is devoted to the discussion of the absolute value of entropy (Nernst's theorem). As an illustration of the place which Planck's "Thermodynamics" occupies, it may be mentioned that a fourth German edition has already appeared this year. It is high time that the English translation was brought up to date.

W. C. McC. L.

OUR BOOKSHELF.

The Annual of the British School at Athens. No. xviii. Session 1911–1912. Pp. viii + 362 + 15 plates. (London: Macmillan and Co., Ltd., n.d.) Price 25*s.* net.

The eighteenth volume of the Annual of the British School at Athens for the session 1911–12 is fully up to the level of this excellent series. The chief archæological article gives an account by Messrs. A. J. B. Wace and M. S. Thompson of the excavations at Halos, one of the smaller and less-known cities in Thessaly. A group of tombs at the foot of the acropolis was opened. Such cist graves formed of slabs are common in Thessaly, both in the fourth prehistoric period and in the Early Iron Age, to which the Halos tombs belong. Here there is no sign of cremation, simple inhumation being the only process. On the other hand, the excavation of a neighbouring tumulus proved that here corpses were burned. Thus in these two cemeteries we find two different methods of disposal of the dead. From an examination of the pottery and fibulæ it seems clear that the cremation tumulus is of a date later than that of the cist graves, and it may be referred to the middle of the so-called Geometric period, about the ninth century B.C. No exact parallel to this type of cremation burial has yet been found in Greece or elsewhere, and it differs from that of Halstatt and the rites described in the Homeric poems in some important particulars. The tumulus is clearly post-Homeric, and may be an Achæan burial in a degenerate or modified form.

Mr. M. N. Tod's paper on Greek numerical notation is of special importance. By a review of the epigraphical evidence he seeks to determine the numerical systems employed in the various Greek cities, and to state afresh some of the conclusions which we are entitled to draw from it. This paper is devoted only to the so-called "acrophonic" or "initial" class of numerical notation, the consideration of the other main type, in which the letters are used in their alphabetical order as numerical signs, being reserved for later treatment. The earliest example of this type appears to belong to the fifth century B.C., and the diversity of the systems employed in the various cities seems to be due to the modifications introduced into the pure numbers to make them capable of expressing money, weights, and measures. The detailed epigraphic evidence thus presented deserves the attentive study of students of the early history of mathematics.

The New Encyclopaedia. Edited by H. C. O'Neill. Pp. vii + 1626. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 7*s.* 6*d.* net.

This encyclopædia is handy in shape and fairly light in weight, and considering the limits of size, it appears to be as complete and authoritative as can be expected. The expert in any branch of knowledge may note the omission of facts which he might think could have been included, but the general reader will find brief summaries on many topics. He will, therefore, find this volume useful, and will be able to continue his studies under the guidance of the bibliography which is appended to the more important articles. The information appears to be accurate and modern, but some of the less informative maps might have been omitted.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Reflection of γ Rays from Crystals.

In some recent investigations Prof. Rutherford and Mr. H. Richardson have analysed the γ radiations emitted by a number of radio-active products. They have shown, for example, that radium B emits three distinct types of γ radiation, which are absorbed exponentially by aluminium with absorption coefficients $\mu=230$, 40, and 0·51 (cm.)$^{-1}$ respectively. On the other hand, radium C appears to emit essentially only one type of γ radiation, the absorption coefficient of which is $\mu=0{\cdot}115$ in aluminium.

Recently we have undertaken an examination of these types of radiation by the methods developed for X-rays by W. H. and W. L. Bragg, and by Moseley and Darwin, which consist in determining, either by the photographic or electric method, the intensity of the X-rays reflected from a crystal at different angles of incidence. In our experiments the source of γ radiation was a thin α-ray tube containing about 100 millicuries of emanation, the γ rays arising from the products of the emanation, radium B and radium C. A diverging cone of rays fell on a crystal of rock-salt, and the distribution of the reflected radiation was examined by the photographic method. The source and photographic plate were each about 10 cm. from the centre of the crystal. Suitable precautions were taken to reduce to a minimum the effect on the photographic plate of the primary and secondary β rays and penetrating γ rays. The source was first arranged so that the radiation made an average angle of about 9° with the face of the crystal.

It was calculated from the known data of the crystal that the radiation $\mu=40$ from the radium B, if homogeneous, should be strongly reflected at about this angle. A group of fine lines comprised between the angles 8° and 10° have been observed on the photographic plate in a number of experiments. Similar results have been observed with a crystal of potassium ferrocyanide, kindly loaned to us by Mr. Moseley. On examining the reflection for an angle of 2° another series of fine lines was obtained on the plate, probably resulting from the reflection of the more penetrating radiations from radium B and radium C.

The experiments indicate that the γ radiation for which $\mu=40$ is complex, and consists of several groups of rays of well-defined wave-length. Experiments are in progress to examine carefully the character of this reflected radiation, both by the photographic and electric method. It is hoped that in this way definite evidence will be obtained on the constitution and wave-length of each of the types of γ radiation which are emitted from radium B and radium C.

E. RUTHERFORD.
E. N. DA C. ANDRADE.

The University, Manchester.

The Piltdown Skull and Brain Cast.

Now that my friend Prof. Keith has explained (NATURE, October 16, pp. 197–99) so lucidly his reasons for making a big brain-case of the Piltdown fragments it is possible to define precisely the point at issue between us.

I should say at the outset that any anatomist, working with the plaster casts but without reference to the actual fragments from which they were moulded, might solve the extraordinarily difficult problem of reconstruction of the cranium in the way Prof. Keith has explained so plausibly. But the bones themselves present features which make such a solution altogether inadmissible. Anyone who examines the left parietal and temporal bones cannot fail to recognise that there is no room for any doubt as to the relative positions of these bones the one to the other, which is not that claimed for them by Prof. Keith.

The right parietal fragment and the occipital can be put into their proper positions and the symmetry of the two branches of the lambdoid suture be restored without producing "any marked asymmetry of another kind," such as troubled Prof. Keith, and without the necessity of making any such liberal additions to the capacity of the cranium as he demands (see his Fig. 2).

The "marked asymmetry of another kind" that he could overcome only by the adoption of the most drastic measures was created wholly by his refusal to admit the possibility that the middle line in the parietal region, as determined by Dr. Smith Woodward, was a close approximation to the truth.

The determination of the précise location of the middle line in the frontal and parietal regions is one of quite exceptional difficulty, but a number of facts and considerations make it certain that it is not where Prof. Keith would place it.

The crux of our difference, then, is the criteria which Prof. Keith uses for determining the middle line in the posterior parietal region. He writes (*op. cit.*, p. 198 *et seq.*):—"In the skulls of all the higher primates, the longitudinal sinus, near the hinder end of the adjacent margins of the right and left parietal bones, is marked by a narrow deep groove with distinct edges; on the margin of the upper angle of the Piltdown fragment the edge or margin of this groove can be clearly recognised."

It must be remembered that the area in question (the "upper angle" of the quotation) is immediately above the middle part of the lambdoid suture, which is preserved upon the larger parietal fragment. Prof. Keith does not seem to have realised this fact, for he represents the lambdoid suture (in his Fig. 2) as a large arch (A, B, A, B) crossing the middle line a short distance below the larger bone fragment. If a series of human and simian cranial casts be examined it will be found that, contrary to Prof. Keith's statement, in a considerable proportion of them there is no trace whatever (in the place just above the lambda corresponding to that preserved in the Piltdown specimen) of "the narrow deep groove with distinct edges" on which Prof. Keith relies as his guide for the determination of the middle line. This is especially the case in the casts of the more primitive human and the simian crania, as Profs. Boule and Anthony have pointed out in their discussion of the Chapelle-aux-Saints and La Quina brain-casts.

On these grounds Prof. Keith "moved the left parietal bone outwards or rather tilted [it] upwards and outwards until it assumes a more vertical position" (p. 199). But in order to do this he had to get rid of one of "the peculiar features of the original brain-cast—the sharp bending inwards or kinking of the temporal lobe of the brain" (p. 199). If Prof. Keith had not opened out the angle between the left temporal and parietal bones the aperture of the ear would have been made to look towards the neck, when he "tilted the left parietal upwards and outwards"! But the precise relationship of the left temporal and parietal bones is not a matter of argument but of fact; no one who examines the actual fragments and sees how precisely the edges of these bones fit one on to the other can refuse to admit that the parieto-temporal angle of Dr. Smith Woodward's restoration is a genuine peculiarity of this skull. If this is admitted it becomes impossible to tilt the upper margin of the parietal upwards and outwards. In other words, this peculiar articulation of the temporal bone affords confirmatory evidence of the proper location of the middle line.

It is a very interesting fact that the curious conformation of the temporal region of the brain, to the reality of which Prof. Keith objects, is quite analogous to that exhibited in the remarkable cranial cast of the Gibraltar skull, of which he is the custodian, and in some of the casts of primitive crania (negro, Australian, and Tasmanian) which he kindly obtained for me.

The greater part of Prof. Keith's letter deals with the lack of symmetry in the original reconstruction, which was due to a slight error in the positions assigned to the occipital and right parietal fragments. The need for this correction was realised before the meeting of the Geological Society last December; and this was taken into consideration when I was writing my preliminary note. G. Elliot Smith.

The University of Manchester.

"Aëroplanes in Gusts."

I shall esteem it a favour if you will spare a little space in which to refer to the unsigned review of the first edition of my book, "Aëroplanes in Gusts," printed in Nature of October 2.

It is not at all my intention to refer to or contest an adverse opinion standing alone, but there is associated with that opinion, in a way that might appear to justify it, a misstatement of fact that I can scarcely be expected to pass without an endeavour to correct.

Your readers are informed that I "measure the effect of a gust of wind by the accelerations of the air particles relative to the aëroplane." That I certainly do not do, and your reviewer has no excuse whatever, in anything I have written, for attributing to me so simple and foolish an error as the words imply. A most casual reading of my book, even in its first pages, shows, decisively, that I quite properly measure the gust—not "the effect of a gust," whatever that may mean—by the acceleration of headway, or acceleration of the velocity relative to the air, which, independently of that due to gravity and even of that due to the propeller, is being *impressed* upon the flying machine by the air.

The confusion made possible by not maintaining or exhibiting, as I have done in my book, the distinction between an actual acceleration and an impressed acceleration, and by not excluding the gravitational acceleration, scarcely needs enlarging upon or explaining in the columns of Nature.

S. L. Walkden.

Muswell Hill, N., October 4.

I have just received the second edition of "Aëroplanes in Gusts," and in reply to the author's criticism of my review, I cannot do better than quote the passage on p. 2 containing the definition:—

"Using therefore the term 'headway' in place of the cumbersome 'velocity relative to the air,' it will be taken for granted that the reader knows that:—

"(1) The instantaneous *strength* of gust at any point of the air as regards a given flying-machine flying at that point is measured by the acceleration of headway which any singularity of the air at that point is impressing upon the flying-machine, and the *direction* of the gust is opposite to the direction of the impressed acceleration.

"For example:—If the air is accelerating downwards at 40 ft. p.s. p.s., it is impressing upon the flying-machine an upward acceleration of headway of 40 ft. p.s. p.s., and this is the measure of the downward gust. In other words, the gust is of strength 40 ft. p.s. p.s., downwards. Simple velocity as distinguished from rate of change of velocity is, it will be noticed, completely ignored."

(The author then goes on to point out that accelerations may be represented by straight lines. Agreed.)

On p. 4 he says:—

"The general method of finding the impressed accelerations acting at a given instant upon a flying-machine consists in first answering the question:—

"If at any given instant the flying-machine could be suddenly transformed to a small smooth concentrated mass, how would it accelerate relative to the air?

"The acceleration answering the above question is the 'resultant relative gravity' of the following discussion, and when common gravity is subtracted *in vector sense* the result is the acceleration tendency or impressed acceleration due to the gusts. When from this result the impressed acceleration due to the absolute acceleration of the air at the place of the flying-machine is also subtracted *in vector sense* there will usually be found an impressed acceleration remaining. This is due to the air having what is called "velocity structure" at the point, and to the flying-machine in crossing that structure creating for itself a rate of change of headway."

If Mr. Walkden considers that he has received any injustice through the use of the term "effect of a gust" in substitution for his reference simply to "a gust," or the measure thereof, the reference to "effect" should certainly be withdrawn. But as regards his views on "impressed accelerations," the above quotations will probably appeal to readers of Nature far more effectively than any criticism, however adverse. Yet several journals have reviewed the book favourably, and it has run into a second edition.

The Reviewer.

Mass as a Measure of Inertia.

Can any of your readers enlighten me as to the authorship of the definition, "The mass of a body is the dynamical measure of its inertia"? I am under the impression that it is due to Clerk Maxwell, but have not been able to find where it occurs. I should be grateful for information as to where to look for it. W. C. Baker.

School of Mining, Queen's University, Kingston, Ont., October 13.

ENGINEERING RESEARCH AND ITS COORDINATION.

The questions of the coordination and encouragement of research in engineering have been brought forward in various ways recently. In April Sir Frederick Donaldson, chief superintendent of Woolwich Arsenal and president of the Institution of Mechanical Engineers, referred to them in his presidential address. At the recent summer meeting of the same institution held in Cambridge, Mr. G. H. Roberts, of Woolwich, read an interesting paper entitled "A Few Notes on Engineering Research and its Coordination," while the matter was also touched upon by the president of the Institution of Water Engineers in his presidential address.

"I have long thought," he says, "and indeed it must be obvious to all who reflect upon the subject, that a great mass of experimental work is lost to the community because the results in many cases are not properly recorded, and even when complete records are kept, the results remain with the investigator," and after referring to the advantages of combining for research the experience and opportunities of a number of people, he continues:—"It occurs to me therefore to ask whether it is possible to make this institution"—the Institution of Water Engineers—"a clearing house for the handling of some at least of the many problems to which we devote time and thought."

Again, Sir Frederick Donaldson writes:—

Research in the hands of firms and engineering undertakings has already been advocated, and no one would wish to see such efforts in any way hampered, but if it were possible to coordinate the work more than is done at present, and also to place the results at the disposal of the profession more readily than is now the case, great advantage may be expected to result. Is it not worth considering whether inquiries should not be made to see if an Engineering Research Committee, the bounds of which should be much wider than membership of this institution alone [the Institution of Mechanical Engineers] could be got together with a view to organising, coordinating, and assisting research, more especially for engineering purposes?

Mr. Roberts's paper commences with the statement that

Although engineering as an applied science has now reached a high state of development, and has in many of its branches become highly specialised, it is somewhat remarkable that no definite and generally recognised system has been formulated for making known for the benefit of the profession as a whole the results of the numerous private researches and experiments which are continually being carried on.

The paper describes a few of the researches of general interest carried on at Woolwich Arsenal

with the hope that it may induce others to come forward and add to the stock of general knowledge and it may thus form the nucleus of a clearing house of engineering information.

Sir Frederick Donaldson goes farther than the formation of such a clearing-house; he suggests, as we have seen, in addition the organisation, coordination, and assistance of research: we will return to this point later.

To many readers of Nature interested mainly in branches of science other than engineering, the need for a clearing-house may appear strange. A man after he has carried through a research in chemistry, physics, or one of the biological sciences, is not usually averse to giving his paper to the world. He communicates it to one of the scientific societies. In due time it appears in the journal, and is abstracted into one or more of the numerous and valuable periodicals which undertake such work for the great benefit of other investigators. But it is otherwise with much engineering or other technical research. The work is carried out for a special purpose: to determine the proper material to use in some structure; to see if some alloy which it would be convenient to employ for a certain machine will retain its properties under the conditions of temperature and stress to which it will be subject; to settle the form of bolt or screw-thread which for a given diameter offers the greatest resistance to shocks or impact and the like. Mr. Roberts's paper gives us examples. He records the results of tests on many specimens of timber used in the arsenal; of an investigation into the standard shapes and dimensions of tensile specimens; of numerous experiments on aluminium alloys. He describes a special instrument for indicating the yield-point of tensile specimens, and discusses the effect of the time-factor upon results of tensile testing and the unification of methods of reporting. Any of these investigations might have been carried out in some other works, and the result, when it had been utilised for the job in hand, forgotten and left to pass into oblivion.

Investigations of the kind, though of real value, may scarcely be of sufficient importance to be worked up as a paper for communication to one of the technical societies—always a somewhat elaborate business—and, indeed, results and methods sufficient for the purpose in view, and deserving of record, would be felt not unfrequently to be unsuitable for an evening's formal discussion. Again, there is the desire, sometimes the necessity, to keep the results private, and the disinclination to spend time in working them up for publication. Possibly some of these difficulties could be met by a committee guiding a staff of men whose business it would be to keep in intimate touch with works in which investigations of general interest were going on. The knowledge of these men would enable them to suggest to the committee what researches it was important should be secured for the public: they might assist the workers in preparing these for publication, or, where complete publication was not necessary or desired, in abstracting such parts as could usefully be placed on record. The committee, or the committee's records, would in time become a storehouse of information to be searched by a would-be investigator before he commenced his own experiments. Useful knowledge would be disseminated and overlapping prevented. The difficulties of the attempt are fairly obvious. Success, if it could be achieved on a sufficient scale, would be a real advantage to engineers.

But this is distinct from Sir Frederick Donaldson's suggestion of organising and advising as to research. To attempt this for the whole field of engineering science is a heavy task, and it may be questioned whether such work is not better done by a number of special committees, each working in a more limited field. Possibly a main committee like the main committee of the engineering standards committee is wanted to start the subordinate bodies and coordinate their work. Such special committees do exist at present. Prof. Hopkinson mentioned in the discussion on Mr.

Roberts's paper the gaseous explosions committee of the British Association. The alloys research committee of the Institute of Mechanical Engineers; the newly established research committee of the electrical engineers; the reinforced concrete committee of the civil engineers; or the Government Advisory Committee for Aëronautics, are all instances. For the success of such committees three things are needed—a man or men to carry out the research, a laboratory or works with proper equipment for the experiments, and funds to defray the expenses.

Prof. Hopkinson did well in the discussion at Cambridge to direct attention to the individuality of research. Much—everything—depends on the man, and he must have freedom. The committee may specify the objects of the inquiry, and indicate in general terms the methods to be followed, but no real result will ensue unless the investigator has ideas of his own, and, after the suggestions laid before the committee are approved, is free to carry them out.

The gaseous explosions committee owes its success to Dugald Clerk and Hopkinson; the alloys research committee to Roberts-Austin, Carpenter, and Rosenhain; while the work of the Advisory Committee for Aëronautics would lose nearly all its value were it not for the energy and devotion of the staff of the National Physical Laboratory.

Engineering research—technical research, indeed, of all kinds—differs, however, from much scientific research in that it can be organised. The problems proposed are usually fairly definite. What are the properties of a certain series of alloys? How are they modified by temperature, forging, annealing, and the like? Do the results of impact tests depend on the form and dimension of the specimen? What is the exact series of changes of temperature and pressure in the cylinder of a gas-engine? How are the forces and couples on an aëroplane related to its aspect to the wind? The problems may be difficult, the answers may elude inquiry; but, given the man, the laboratory, and the funds, a committee meeting at intervals to discuss the results of the experiments may reasonably hope in time to meet with success.

Sir Frederick Donaldson and his colleagues have raised questions of great interest and importance, well worth the careful consideration of those engaged in bringing the results of scientific inquiry to bear on the problems of manufacture and construction.

HIGHER EDUCATION AND THE STATE.

Lord Haldane had something important to say upon the subject of provision for higher education in the course of his speech at the opening of the new buildings of the department of applied science of the University of Sheffield on Saturday last. An account of his address will be found elsewhere in this issue, but we are more particularly interested in a summary of the main points, communicated by him to representatives of the Press. Lord Haldane explained that he desired it to be realised fully that he was announcing the considered decisions of the Cabinet upon the subject of university education, and was indicating the policy to be followed. The substance of his remarks was expressed as follows:—

The main features of the Board of Education's scheme are a recognition of the great strides being made in university education by the United States and Germany, and an intention to maintain closely the connection between pure science and applied science and to check any tendency on the part of any of the younger universities to cultivate the latter at the expense of the former. Theory and practice must keep together. Men of business must remember that much of what is distinctive in the inventive and industrial genius of this country comes from theoretical sources.

Unless we wake up fully about this matter of education, and particularly higher education, I am a little nervous as to what the state of things with regard to our industrial supremacy will be fifteen or twenty years hence.

The nation will have to make up its mind to give considerably more out of central funds. The plans for these advances are now fashioned. I hate any idea of increasing expenditure, whether out of local or national sources, if it can be avoided. But this cannot be avoided. It is salvage money, and unless you spend it you will go back as a nation, and your revenues by which you keep up your fleets and your armies will begin to shrink, because you will not be holding your own in that great industrial position from which your power and your wealth have come.

We have now, therefore, a definite statement of the position which university work is to take in the national scheme of education adumbrated by various Ministers since the beginning of this year. There is a clear acknowledgment of the fact that in the matter of State provision for higher education we have not kept pace with other progressive nations; that scientific work which has no industrial interest is as important as that of which the direct application can be seen; that national advancement can be secured best by increase of scientific knowledge; and that all these things involve contributions from the national exchequer greatly in excess of those hitherto given.

Readers of Nature scarcely need reminding that the policy thus broadly outlined has been urged consistently and persistently in these columns. Ten years ago, Sir Norman Lockyer, in his presidential address to the British Association at Southport, gave the evidence from which each one of the points mentioned by Lord Haldane could be justified; and since then, year by year, particulars have been given in the reports of the British Science Guild of the progress being made in the endowment of higher education and research abroad, in comparison with the position in this country. It was shown, for instance, in the last report of the Guild, that the total receipts of universities in the United States in the year 1910–1911 amounted to nearly nineteen million pounds, and the benefactions to four and a half millions. In the same year, the total receipts of those universities and university colleges in Great Britain in receipt of grants from the Board of Education was little more than 600,000*l.*, of which amount the total State grant was roughly one half. The State grants to universities in Prussia alone are more than twice as much as are contributed to our universities from the national exchequer.

Lord Haldane may therefore safely say that the United States and Germany have made far greater strides in university education than have been undertaken in this country. When he wrote the introduction to Sir Norman Lockyer's collection of addresses on education and national progress (1906), he suggested that the private donor should be encouraged, but that the motto of the Chancellor of the Exchequer as regards expenditure upon matters connected with higher education and research should be *Festina lente.* "I do not mean," he wrote, "that the Government ought not to spend public money generously upon the universities. I mean that it should not be spent unless and until a case for the necessity of such expenditure has been clearly made out."

We may be permitted to conclude from the address at Sheffield that Lord Haldane is now of the opinion that a case has been made out for increased national provision for our educational forces. He knows as well as anyone that the great advances being made in education in other countries constitute a formidable menace to ourselves, and that the State can wait no longer for like developments if it desires to maintain a leading position among progressive peoples. He has now stated authoritatively that the Cabinet realises our weakness, and accepts the only policy which will remedy it. We have read this pronouncement with lively satisfaction, and shall welcome any measure which will put the policy into effect.

DR. LUCAS-CHAMPIONNIERE.

THE sudden death of Dr. Just Lucas-Championnière has brought regret to many surgeons in this country, who knew the excellence of his character and of his work. He was seventy years old, surgeon to the Hôtel Dieu (the great hospital in Paris, founded by Saint Louis)—Commander of the Legion of Honour, and member of the French Academy. His father was the first editor of one of the chief medical journals of France; his grandfather had been a leader in the heroic war of La Vendée. From the Collége Rollin, Lucas-Championnière went to the Hôtel Dieu as a student, and was *interne* there in 1865. He became one of the most eminent of all French surgeons of his time, and received honours from many countries, including the Fellowship of the Royal Colleges of Surgeons of London and of Edinburgh. He was a great "all-round" surgeon; but he gave especial study to the operative treatment of hernia, and to the management of fractures. His best recreation—so far as he had time for it—he found in music.

To us over here—some of us may remember his genial presence in London during the 1881 International Medical Congress—he stands for the introduction into France of Lister's antiseptic method. He in France, and Saxtorph in Denmark, were the teachers of the new learning. He came to Glasgow in 1868, and Edinburgh in 1875, that he might learn for himself, watching Lister himself, every detail of the method. He so worshipped the work of Lister that, in the later years of his life, he resented the changes of method, the preference for things "aseptic" over things "antiseptic"; he hoped that surgery would return to "Lister's own method." There are few surgical books more pleasant to handle than his "Pratique de la Chirurgie Antiseptique"—with its portrait of Lister for a frontispiece, and the loyalty and devotion of the writing. It is pitiful to think how slow was the spread of the new learning; what misery was added, for want of the antiseptic method, to the misery of the Franco-German War; what unbelief, and worse than unbelief, delayed the universal recognition of Lister even in our own country.

NOTES.

A Royal Commission has been appointed to inquire into the subject of venereal diseases in the United Kingdom. The terms of reference are:—To inquire into the prevalence of venereal diseases in the United Kingdom, their effects upon the health of the community, and the means by which those effects can be alleviated or prevented, it being understood that no return to the policy or provisions of the Contagious Diseases Acts of 1864, 1866, 1869 is to be regarded as falling within the scope of the inquiry. The members of the Commission are:—Lord Sydenham of Combe, G.C.S.I., F.R.S. (chairman), the Right Hon. Sir David Brynmor Jones, K.C., M.P., Mr. Philip Snowden, Sir Kenelm E. Digby, G.C.B., K.C., Sir Almeric FitzRoy, K.C.B., Sir Malcolm Morris, K.C.V.O., Sir John Collie, Dr. A. Newsholme, Canon J. W. Horsley, the Rev. J. Scott Lidgett, Dr. F. W. Mott, Mr. J. E. Lane, Mrs. Scharlieb, Mrs. Creighton, and Mrs. Burgwin. The secretary to the Commission is Mr. E. R. Forber, of the Local Government Board, to whom any communications on the subject may be addressed.

By Order in Council dated October 14 new denominations of standards of the metric carat of 200 milligrams and its multiples and submultiples have been legalised for use in trade in the United Kingdom on and after April 1, 1914. The permissible abbreviation of the denomination "metric carat" is "C.M." The weights legalised range from 500 C.M. to 0·005 C.M., the series being 5, 2, 1 throughout. The legalisation of the metric carat has been undertaken by the Board of Trade after consulting representatives of the trade in diamonds and precious stones, and is the outcome of a resolution passed at the General Conference on Weights and Measures, held in Paris in 1907, advocating the adoption of an international standard carat. Diamond dealers in this country were at first opposed to any change, and it is only quite recently that they have found it necessary to reconsider their views on the subject, owing to the progress made on the Continent in enforcing the adoption of the metric carat. The new standards are intended to displace the old English carat weight, which has never had legal sanction, but has long been in use in this country, and is recognised by the trade as defined by the relation $151\frac{1}{2}$ carats = 1 oz. troy, so that it is equivalent to 3·1683 grains, or to 205·3 milligrams nearly.

By the death of Mr. William Hunting, on October 24, the veterinary profession has lost one of its most brilliant members, and the public in general one of its most strenuous workers in the cause of public health, especially in relation to the prevention of diseases transmissible from animals to man. Mr. William Hunting was born in 1844, receiving his early education at the Edinburgh Academy, and his professional training at the New Veterinary College, Edinburgh. He obtained his diploma of membership of the Royal College of Veterinary Surgeons in 1865, and became a fellow in 1877. His former teacher, Prof. Gamgee, established a veterinary college in London, and selected him to teach anatomy and physiology, and after a while Mr. Hunting was appointed professor of veterinary science at the Royal Agricultural College, Cirencester. He did not retain this chair for long, and eventually he settled in general practice in London, where he was brought into daily contact with glanders in horses, a disease with which his name will always be associated. He was later elected to the council of the Royal College of Veterinary Surgeons, and became its president, the highest honour his profession could bestow on him, in 1894–5. Mr. Hunting was acknowledged to be the greatest authority on clinical glanders, and it was mainly owing to his efforts that the London County Council instituted its campaign against this disease which was so easily communicable to man, and almost invariably fatal. For this purpose the L.C.C. appointed him as its chief inspector, from which post he retired under the age limit. He lived, however, to see the disease got well under control with every prospect of its being completely eradicated in a comparatively few years. He published an illustrated monograph on glanders in the horse and in man, the best work in existence on the disease, and he has also contributed the chapter on this affection in Hoare's "System of Veterinary Medicine." He had only recently been invited to provide a paper on the same subject for the International Veterinary Congress, which will meet in London in 1914. He founded and edited *The Veterinary Record*, and published a standard work on horse-shoeing, and was also a prolific writer to the veterinary Press. Amongst the many offices he held at the time of his death, Mr. Hunting was president of the National Veterinary Association, examiner for the membership and fellowship of the Royal College of Veterinary Surgeons, examiner for the membership of the Royal Agricultural College, and for the meat inspector's certificate of the Royal Sanitary Institute. He was also a member of the board of studies in veterinary science in the University of London, and a governor of the Royal Veterinary College.

Dr. F. H. Hatch has been elected president of the Institution of Mining and Metallurgy for the forthcoming year.

Mr. Stephen Reynolds, a member of the Departmental Committee inquiring into the condition of the inshore fisheries, has been appointed adviser on these fisheries to the Development Commission.

Dr. H. R. Mill, director of the British Rainfall Organisation, has been compelled to take a complete rest for a time on account of his eyes, which have been affected by the continual strain of his work. He will leave next month for a voyage to New Zealand, and is advised not to attempt to take up for at least a year any work which involves close attention. It is hoped that the rest and change will have a decidedly beneficial effect upon Dr. Mill's eyesight and general health.

The young Malay elephant at the Zoological Gardens, which had been ailing for some time, died in the latter part of last week. The skin has been consigned to Messrs. Rowland Ward, Ltd., by whom it will be mounted for the Natural History Museum. At the time of its death the animal, although about three years old, still retained the hairy coat of new-born Asiatic elephant calves.

In *The Field* of October 25 Mr. R. I. Pocock records the acquisition by the Zoological Society of the second known example of the South American short-eared dog, or fox (*Canis sclateri*). The first specimen was acquired by the society in 1882, and described by Dr. Sclater under the preoccupied name of *C. microtis*. In neither case is the precise habitat known, but Mr. Pocock, who also refers to the peculiarity of the association of short ears with small bodily size, considers that the species is probably a forest animal.

An exhibition of "Nature Photographs," organised by the Nature Photographic Society, is now being held at the house of the Royal Photographic Society, 35 Russell Square. It consists of 132 photographs of birds, animals, flowers, fungi, insects, &c., generally of a high order of merit, and many of them by workers who have earned a considerable reputation for work of this kind. Admission to the exhibition is by presentation of visiting card, between 11 and 5, until November 15. The photographs shown are just of the kind that must appeal to those interested in nature-study.

The annual dinner of the London School of Tropical Medicine was held at Prince's Restaurant on October 24, Dr. F. M. Sandwith presiding, and among those present were Lord Milner, Mr. Percival Nairne, Sir Charles Lukis, Sir J. West Ridgeway, Sir John Anderson, Surgeon-General May, Sir Patrick Manson, and many others. Mr. Austin Chamberlain, proposing the toast of the school, referred to the progress which tropical medicine has made during the last twenty-five years, and said that it is a matter of national pride that in so beneficent a movement our countrymen stand in the forefront in regard to the new learning which is being acquired. The London School has appealed for a sum of 100,000*l*. for endowment, research, and endowment of beds for certain tropical cases, of which about 70,000*l.* has been obtained. A pleasing event of the evening was the presentation to Sir Patrick Manson, the *doyen* of tropical research, of two portraits of himself on behalf of the subscribers, by Mr. Cantlie and Dr. Prout, representing the London and Liverpool Schools respectively.

A violent wind-storm passed over part of Wales on Monday night, October 27, causing damage roughly estimated at between 30,000*l.* and 50,000*l.*, and the loss of two lives, as well as injuries to many people. Two men named Woolford and Breeze were walking arm-in-arm when they were caught by the wind and blown a distance of thirty yards. Woolford fell on his head and was killed, and Breeze had two ribs fractured. From the position in which the dead body of a man named Harries was found in a field near Abercynon it is believed that the man must have been carried 300 or 400 yards by the force of the gale. Along the whole Taff Valley, from Treforest past Cilfynydd and by Quakers Yard to Treharris wrecked structures and up-rooted trees mark the path of the storm. It was first felt at Treforest, and it seemed to gather force as it entered the valley at Cilfynydd. Along the whole way the storm was confined to a path about 200 yards wide.

At the annual public meeting of the Five Academies, held last week at Paris, a paper on the subject of prehistoric trepanning was read, by the late Dr. Lucas Championnière; it dealt with instances of the operation, beginning with the first discovery of such a skull by M. Prunières under a dolmen in the Lozère, among the cave men, the ancient Gauls, and the pre-Columbian Americans. These people performed trepanning by means of flints, and the writer had succeeded in piercing the skull of an adult in the dissecting-room in thirty-five minutes by means of a flint, which was not specially sharpened. He attributed the skill of these early surgeons to the now lost art of rotating instruments in fire-making. The operation was performed in the case of serious skull wounds, and also to relieve headache and epilepsy, by releasing the spirit to which the attacks were attributed. He himself had seen a native at Biskra, in Algeria, whose head showed four perforations, and he and his brothers asserted that they had trepanned their own father twelve times. It is remarkable that the operation was not practised among highly civilised races, like Greeks, Egyptians, Arabs, Hindus, and Chinese, or among some peoples of low culture, like African negroes.

At the annual general meeting of the Royal Society of Edinburgh, held on October 27, the following office-bearers and councillors were elected:—*President:* Prof. James Geikie, F.R.S. *Vice-Presidents:* Dr. J. Burgess, Prof. T. Hudson Beare, Prof. F. O. Bower, F.R.S., Sir Thomas R. Fraser, F.R.S., Dr. B. N. Peach, F.R.S., and Sir E. A. Schäfer, F.R.S. *General Secretary:* Dr. C. G. Knott. *Secretaries to Ordinary Meetings:* Dr. R. Kidston, F.R.S., and Prof. A. Robinson. *Treasurer:* Mr. J. Currie. *Curator of Library and Museum:* Dr. J. S. Black. *Councillors:* Prof. T. H. Bryce, Mr. W. A. Carter, Mr. A. Watt, Dr. J. H. Ashworth, Dr. J. G. Gray, Prof. R. A. Sampson, F.R.S., Prof. D'Arcy W. Thompson, C.B., Prof. E. T. Whittaker, F.R.S., Principal A. P. Laurie, Prof. J. Graham Kerr, F.R.S., Dr. L. Dobbin, Mr. E. M. Wedderburn. It is worthy of note that the presidents of the Royal Societies of London and of Edinburgh are brothers, natives of Edinburgh, and both geologists.

At the annual general meeting of the Cambridge Philosophical Society, held on October 27, the following officers and council were elected:—*President:* The Master of Christ's. *Vice-Presidents:* Prof. Pope, Dr. Barnes, and Prof. Seward. *Treasurer:* Prof. Hobson. *Secretaries:* Mr. A. Wood, Mr. F. A. Potts, and Mr. G. H. Hardy. *Other Members of Council:* Sir J. J. Thomson, Mr. J. E. Purvis, Mr. R. P. Gregory, Dr. Cobbett, Mr. J. Mercer, Dr. Marshall, Mr. G. R. Mines, Mr. F. J. M. Stratton, Prof. Woodhead, Mr. C. Forster Cooper, Mr. C. E. Inglis, and Dr. Duckworth.

At the annual meeting of the Prehistoric Society of East Anglia, the honorary secretary made an announcement, which will be welcome to archæologists, that the society proposes to undertake a survey of Grime's Graves, at Weeting. A few of these constructions were superficially studied in 1852, and one was carefully examined by Canon Greenwell in 1870. But much still remains to be done, and the importance of flint implements of the Cissbury type found in the caves has been greatly increased by the suggestion of Mr. Reginald Smith that they are analogous to those of the Aurignacian age found on the Continent. Contributions are invited for the prosecution of this undertaking by Mr. W. G. Clarke, 12 St. Philip's Road, Norwich. The president, Mr. J. Reid Moir, discussed the fractured flints found in the Eocene "Bullhead" bed at Coe's Pit, Bramford, near Ipswich, with special reference to the views of M. Breuil, who is inclined to regard the fractures as the result of natural pressure. The Ipswich bed is now overlaid by some 40 ft. of deposits, partly sand, and it is difficult to imagine how pressure on the lower strata could have been exercised through such a medium. Mr. Reid Moir concludes, from experiments, that pressure may account for the fractures. If this be the case, it must have been exercised before the deposition of the present overlying strata. In later beds the "human touch" is sufficiently obvious, and it is thus possible to differentiate one type from the other with some confidence.

The Eugenics Review for October (v., No. 3) contains matter of much interest for the citizen. The Chancellor of Stanford University, U.S.A., writes on the eugenics of war, pointing out that it is the best part of the population that becomes the military, and that a country, therefore, by the ravages of war, suffers not only at the time but for generations afterwards. "Wars are not paid for in war-time; the bill comes later," as Benjamin Franklin said. Mr. Sören Hansen marshals evidence on the inferior quality of the first-born children, and a State not only loses citizens by the limitation of families, but is also penalised thereby by a deterioration in racial quality.

The monograph published by Prof. P. N. Ure, and issued by the Oxford University Press, on black glaze pottery from Rhitsona in Bœotia (pp. 63+xix plates, price 7*s.* 6*d.* net) is a useful contribution to our knowledge of Greek ceramics. Our information on the history of the Bœotian federation from literary sources is confined to Thebes; that of the minor members must be discovered by the spade. If this pottery could be accurately dated it would supply much useful evidence. The present monograph has established the leading facts, which must be supplemented by further excavation and examination of the material.

The Danysz rat virus, consisting of a cultivation of a microbe which produces a fatal infectious disease among rats, has been used with considerable success for the extermination of rats in many districts. The accompanying illustration shows the preparation of the "bait," made by impregnating crushed oats with the virus, for use in Kaltern, a village in the Austrian Tyrol, which had suffered severely from an invasion of field rats.

Saturating crushed oats with Danysz virus at Kaltern, Austrian Tyrol.

The age of the earth has long been a favourite topic for discussion, and conclusions have been arrived at from time to time remarkable mainly for their variety. This variety is likely to characterise for a long time to come other conclusions that may follow, for the simple reason that at present we lack the data for dealing with the subject in a comprehensive way. Estimates of geologic time, founded upon one set of facts and assumptions, are found to be difficult to square with those based upon other and equally trustworthy sets. Mr. H. S. Shelton considers some methods of attacking the problem in the October number of *Science Progress*. He points out the absence of sufficiently good data for the average rate of erosion of rocks, and suggests that further information could be obtained if we possessed fuller details concerning the extent of particular local formations. Of the geochemical methods he thinks the best is probably that based on calculations concerning the amount of limestone in the rocks of the earth; and from Mellard Reade's deductions he believes it is "possible to assess a probable minimum of the order of 500,000,000 of years." Respecting the estimates of Strutt, based on the study of helium and radioactive minerals, he says: "The most we can now infer is a moderate minimum of time, a result that is given equally well by other data if properly handled." Concerning biological evidence, he says: "The biologist has no independent standard of time. Vague as are the data of the geologist, those of the biologist are still more uncertain." Finally: "What we are entitled to say on the evidence before us—biological, geological, and physical—is this: It would be absurd to attempt, on very insufficient data, to give an estimate of the probable lapse of geologic time. But there is, at the present day, no reason whatever why it should not be a thousand million of years or a time even greater." This does not carry us very far, and Mr. Shelton's suggestions for further study of the problem are somewhat trite.

The October number of *The Entomologists' Monthly Magazine* contains a memoir and portrait of the late Dr. O. M. Reuter, the celebrated hemipterist, who died on September 2, in his native town of Abo, at the age of sixty-three.

The report of the Entomological Society of Ontario for 1912 mainly deals with the infestations of injurious insects in the Dominion and the best means of keeping them in check. Great aid in this work has been afforded by the establishment of field laboratories in various districts, which have enabled investigations to be carried on over much wider areas than was previously possible. Another feature of the year's work has been an increased importation of parasitic enemies of some of the most noxious insects, notably the introduction of cocoons of the larch-sawfly infected with an ichneumon-fly from the English Lake District.

The beautiful colours of thin films observable with Mr. C. V. Boys's scientific toy, "The Rainbow Cup," were referred to in a Note in our issue of January 23 of this year (vol. xc., p. 579). A cheap form of the instrument is now available from Messrs. J. J. Griffin and Sons, Ltd., the price being 2*s.* 6*d.* only instead of 25*s.* Though the new form is, of course, not so good as the more expensive instrument, it shows the changing colour patterns in a very pleasing way, and should interest a large section of the general public. An explanatory pamphlet is included in the box containing the instrument and the soap solution.

The Royal Meteorological Institute of the Netherlands has issued a useful paper on the rainfall of that country (*Mededeelingen en Verhandelingen*, 15), with maps and tables showing the annual and seasonal distribution. The work is a continuation prepared by Dr. Hartman of one published by Engelenburg in 1891, since which time the number of stations has greatly increased, and is the first instalment of a general climatology of the Netherlands. In addition to the annual means for the whole period, which differs for each station, all the means for the twenty-five years, 1881–1905, have been calculated, as this period has been adopted as a normal time for comparison by the Solar Commission of the International Meteorological Committee. The extreme annual values for this series vary from 828 mm. (32·6 in.)

at Leeghwater (South Holland) to 596 mm. (23·5 in.) at Kampen (E. Zuider Zee). The rainfall diminishes considerably near the coasts; at some distance from these it increases, and afterwards the diminution becomes progressive and general with distance from the sea. The maximum values occur in July, August, and October; the minimum values occur generally in February and April. In July the increased rainfall is due chiefly to thunderstorms.

THE present autumn has many meteorological features of especial interest. Only one-third of the autumn now remains, and although there is ample time for a thorough change to set in, there are at present no indications of generally colder conditions. The weekly reports issued by the Meteorological Office show an excess of temperature since the close of summer at the end of August, in all parts of the British Isles, and over England and Ireland the excess amounts to 3° for the period embraced by September and October. The absence of low temperatures is very pronounced, and at Greenwich the lowest shade temperature for October is 36°, while to October 28 there were nine nights with the thermometer above 50°. In October last year sharp frost was experienced on October 5 and 6, but it is not altogether uncommon to escape frost throughout the month, and in 1910 the lowest temperature at Greenwich for October was 39·6°. On twenty-one days out of the first twenty-eight days in October this year the shade temperature at Greenwich had exceeded 60°, and even towards the close of the month such high temperatures were fairly common. The autumn rains have so far been in excess of the average over the midland and eastern districts of England, but there is generally a deficiency in the western districts.

IN his remarks on Dr. Bohr's letter on the spectra of helium and hydrogen, in NATURE of October 23, p. 232, Prof. Fowler referred to certain corrections required in the wave-lengths calculated for the lines near $H\beta$, $H\gamma$, &c., as given in the original submitted to him. Dr. Bohr, however, corrected these wave-lengths in the proof, thus rendering Prof. Fowler's corrections unnecessary. We are asked to mention this in order to remove any ambiguity to which the reference to corrected wave-lengths may have given rise.

THE September number of *Terrestrial Magnetism and Atmospheric Electricity* devotes twenty pages to an account of the magnetic work of the Astronomer Royal, Edmund Halley. In 1698 he was placed in command of the *Paramour Pink* in order "to improve the knowledge of the longitude and the variations of the compasse." He spent two years taking observations in the Atlantic between latitudes 50° N. and 52° S., and published his results in a "General Chart of the Variations of the Compass" in 1701. The journal in which he entered all his observations is reprinted under the editorship of Messrs. Ault and Wallis, of the department of terrestrial magnetism, and Dr. Bauer has collected together the references to Halley's magnetic work in the journals of the Royal Society, and gives reprints of the letterpress which accompanied the sea charts of the western and southern oceans, and of the whole world.

SOME interesting results are recorded by Messrs. F. A. Sannino and A. Tosatti in the *Atti R. Accad. Lincei* (vol. xxii., ii., No. 5) of the effect of manuring grape vines with manganese sulphate. The result of the application is considerably to increase the yield of grapes per hectare, but the must obtained in the vintage is poorer in glucose, and higher in acidity than with the control, carried out on the same land, but without the addition of manganese. The wine obtained after fermentation shows a quite characteristic odour and flavour, and tends to resemble Marsala or Madeira. At the same time a tendency to develop turbidity is shown which is also found in wines when too rich in oxydases. The proportion of manganese present in the ash of the wine is at the same time markedly increased.

COMMENTING on the loss of the German naval airship *Zeppelin L2*, *The Engineer* for October 24 does not consider that present constructive methods will ever render available the tactical superiority of airships. No dirigible balloon has yet been constructed which has fulfilled its function otherwise than by dodging the forces of nature. It is held that both commercially and constructionally, the dirigible balloon of to-day appears to be an absurdity. Further, there is little reason to hope that conditions will change, and that new materials and methods of construction will be made available.

THE "James Forrest" lecture for 1913 was delivered by Mr. Alexander Gracie in the new buildings of the Institution of Civil Engineers on October 23, the subject being twenty years' progress in marine construction. Increase in size of vessel is undoubtedly the most valuable resource of the naval architect, as it leads directly towards the attainment of greater comfort, speed, and economy. Twenty years ago, the premier Atlantic vessel was the *Campania,* 600 ft. in length, 65 ft. in beam, and 41 ft. 6 in. in depth. To-day the largest vessel afloat is the *Imperator,* 880 ft. by 90 ft. by 63 ft. The Cunard liners *Lusitania* and *Mauretania* have been surpassed in size, but still hold their supremacy in speed unchallenged; these vessels maintain an ocean speed of between 25 and 26 knots. The advance has been greatly facilitated by the introduction and development of the steam turbine, which has provided the way to further progress in economy, lightness, and the construction of very large units, while at the same time eliminating vibration troubles and relieving the difficulties of engine-room management. Twenty years ago, the majority of cross-Channel vessels were paddle-steamers. Typical vessels were the paddle-steamer *Calais Douvres* and the twin-screw *Ibex*. The former vessel had a displacement of 1065 gross tons, and engines of 6000 indicated horse-power gave a speed of 20·64 knots. The corresponding dimensions of the latter vessel were 1062 gross tons, 4200 indicated horse-power, and 19·37 knots. The introduction in 1911 of geared-turbines in the *Normannia* and *Hantonia* has led to a great economy in fuel, these vessels using but 43 tons of coal per trip, as compared with 70 tons used by their immediate predecessors of the same capacity, but propelled by direct-driven three-screw turbines. Last summer, the Channel steamer *Paris*, fitted with geared turbines, attained the remarkable speed of 25·07 knots—a result which has only been surpassed by torpedo craft. Hydraulic transmission has lately been developed in Germany, and electrical transmission has also been applied to several vessels. Cargo steamers have advanced from 6400 to 9600 tons dead-weight, at practically constant speed of 11 knots. There are many attractive possibilities in the problem of producing a trustworthy internal-combustion engine able to compete successfully with the steam-engine and geared turbine.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences for November :—

Nov. 1. 16h. 0m. Mercury at greatest elongation east of the Sun.
2. 21h. 18m. Jupiter in conjunction with the Moon (Jupiter 4° 35′ N.).
4. 11h. 32m. Uranus in conjunction with the Moon (Uranus 3° 26′ N.).
5. 8h. 0m. Venus at greatest heliocentric latitude N.
12. 13h. 0m. Mercury stationary.
15. 12h. 25m. Saturn in conjunction with the Moon (Saturn 6° 49′ S.).
18. 7h. 6m. Mars in conjunction with the Moon (Mars 2° 23′ S.).
,, 13h. 21m. Neptune in conjunction with the Moon (Neptune 4° 40′ S.).
22. 18h. 0m. Mercury in inferior conjunction with the Sun.
26. 7h. 33m. Venus in conjunction with the Moon (Venus 5° 41′ N.).
,, 23h. 32m. Mercury in conjunction with the Moon (Mercury 6° 43′ N.).
27. 0h. 0m. Mars stationary.
30. 16h. 5m. Jupiter in conjunction with the Moon (Jupiter 4° 12′ N.).

A New Comet.—A Kiel telegram, dated October 24, distributes the information communicated by Prof. Hartwig that on October 23 Dr. Zinner discovered a comet of the 10th magnitude at 7h. 58·8m. M.T. Bamberg. Its position is given as R.A. 18h. 40m. 1s., and declination −4° 32′ 38″, and the object was observed to have a tail. The comet is thus situated in the constellation of Aquila, a little less than half-way between λ Aquilæ and η Serpentis.

Comet Metcalf 1913*b*.—The following is the ephemeris for Metcalf's comet as calculated by Herr A. Kobold, and published in *Astronomische Nachrichten*, No. 4686 :—

12h. M.T. Berlin.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Oct. 30	20 46 53	+4 25·8	
31	46 31	3 13·9	
Nov. 1	46 13	2 6·1	
2	45 58	1 2·0	9·7
3	45 47	+0 1·5	
4	45 39	−0 55·9	
5	45 33	1 50·1	
6	45 31	2 41·4	9·9

This faint comet is now just moving into the constellation of Aquarius, and is only a suitable object for telescopes of large aperture.

Comet Westphal (1913*d*).—Comet Westphal is becoming a faint object, being now a little fainter than 8·5 magnitude. The following is a portion of the ephemeris published by Hermann Kobold in *Astronomische Nachrichten*, No. 4687 :—

12h. M.T. Berlin.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Oct. 30	20 40 35	+23 16·8	
31	39 38	23 53·8	
Nov. 1	38 46	24 30·4	8·6
2	37 56	25 6·5	
3	37 11	25 42·3	
4	36 30	26 17·7	
5	35 51	26 52·8	8·6
6	35 17	27 27·5	

The comet is moving in the constellation of Vulpecula, and is in a good position for observation.

Elements and Numbers of Minor Planets.—The growth in the number of the minor planets discovered is clearly brought out in the two interesting communications by Dr. Cohn in *Astronomische Nachrichten*, No. 4688. In the first paper he refers to the elements and numbering of these bodies, and points out that in the interval, July 1, 1912, to June 30, 1913, sixty-seven objects have been given provisionary numbers. Five of these have been identified as old members of the group. Of the sixty-two remaining, nineteen hail from Heidelberg, seven from Johannesburg, nine from Neuchâtel, eleven from Simeïs, three from Vienna, and thirteen from Winchester. Of this number twenty-one have had their elliptical orbits checked and numbers assigned to them.

In the second communication Dr. Cohn points out the unsatisfactory state, and possibility of mistakes, in the present system of lettering the planets, owing to their great number, and suggests, with the help of other astronomers, a set of names for the planets from No. 570 to 727. As an example, it may be stated that 697 has been named "Galileo," as it was discovered on the day of the three hundredth anniversary of the discovery of Jupiter's satellites. 727 is termed "Nipponia," as the planet was discovered twice by Herr Hirayama in Tokio.

Theoretical Astronomical Research.—A circular regarding a plan for an institute for theoretical astronomical research has reached us from Lund, Sweden. It is a timely plea for financial support for a neglected part of astronomy. The work suggested as specially suitable to be undertaken by the institute is in the first place the investigations of the orbits of the asteroids, work which it is confidently anticipated will lead to the solution of "the problem of three bodies," and perhaps also solve the enigma of the evolution of the heavenly bodies. This work would be undertaken by three of a proposed staff of eight "theoretical astronomers." Two more would work at the problem of three bodies; to another couple would be assigned various cosmological problems, such as the figure of the heavenly bodies, tides, and related problems. The remaining astronomer would be required to deal with stellar statistics. These men would be of the standing of university professors, and have rather better pay. Each astronomer would have one algebraical computer and two numerical computers at his personal disposal, and should the necessity arise additional computers would be available. The project is conceived in a princely manner, the proposed yearly budget being 200,000 marks (German) (10,000*l*.), and the complete scheme requires a capital sum of 5,600,000 marks (280,000*l*.). Calculating machines, worked by lady computers, would be employed for the numerical calculations, and no fewer than 100,000 marks (5000*l*.) is proposed to be spent on machines.

COMMITTEES ON RADIO-TELEGRAPHIC INVESTIGATIONS.

Organisation of an International Commission.

A MEETING was held in Brussels at the commencement of last month at which the question of organising an international commission to carry out wireless experiments was further discussed. At the International Time Conference in Paris last October a series of resolutions was passed with reference to the formation of an international organisation for the scientific study of Hertzian waves and their relationship to the medium through which they travel. At this conference Mr. Goldschmidt, of Brussels, placed his high-power station at Brussels and the sum of 1000*l.* for preliminary studies at the disposal of the proposed international commission.

Arising out of these resolutions the representatives of the different countries who were present at Brussels last month drafted a provisional constitution for the international commission and a scheme for its work.

The objects of the commission are:—(1) To carry out experiments on the propagation of electric waves. (2) To make wireless telegraph measurements and the study of the problems related therto.

The provisional programme of the work of the commission will consist in making measurements in different countries and at different distances and in different directions of the strength of signals sent out from the station at Brussels. These measurements will be repeated from day to day or hour to hour as necessary in order to determine the variation of the strength of the signals both with time, with distance, and with direction, and later the effect of wave-length and decrement will be studied.

It is proposed to set up a receiving station near the transmitting station in Brussels in order accurately to control the strength of the waves sent out so that an allowance can be made for any unavoidable variation in reducing the final results.

The organisation consists of a number of national committees, one in each of the countries taking part. The national committees will send delegates to the international commission, and these delegates, together with the officers, will constitute the international commission. It is proposed that the international commission should meet once a year, or more often if the work is sufficiently advanced.

The Institution of Electrical Engineers has decided to undertake the formation of the national committee for Great Britain, under the scheme for the organisation and encouragement of electrical research which was announced at the institution meeting on December 12, 1912.

The British Association Committee.

The British Association Committee has now inaugurated an extensive scheme for the making of observations of natural electric waves by means of wireless telegraph receiving apparatus, and is addressing to wireless telegraph experimenters an invitation to cooperate in the making of observations. The records will be collected by the committee and compared and reduced by it.

These natural electric wave trains produce troublesome noises in the telephone receivers of wireless telegraph stations. Some proportion of them are due to lightning strokes within a few hundred miles of the receiving station; but even when there is no thunder weather recorded over the whole continent of Europe and the adjacent seas, they are received continuously by an antenna adjusted to a great wave-length. It has been suggested that some of these wave trains may be due to extraterrestrial causes, and it does not seen unreasonable to suppose that electrical discharges may occur in the sun and may be the source of a proportion of the natural electric wave trains we receive. There is little likelihood of our gaining a knowledge of the causes at work until organised observations are carried out simultaneously at numerous points of the globe and collated at a single centre, such as the committee now affords.

Another and distinct inquiry which urgently needs pursuing is the action of the earth's atmosphere in causing variations of the electric waves used in transmitting messages over long distances. The laws of these variations, especially in respect of their connection with weather conditions, with position on the earth's surface, and with the time of day would, if unravelled, probably throw light on the electrical conditions of the highest parts of our atmosphere. The committee has undertaken this inquiry also.

In carrying on the work the committee looks very largely to private experimenters for the collection of data. But it has been a matter of extreme gratification to find that the Imperial Navy and the British Post Office were willing to help. The Marconi Company also has, with commendable public spirit, promised to give its powerful assistance to the committee. Thus the committee can already make sure that data will be collected on its behalf in all parts of the world. Meanwhile private experimenters who are willing to assist the committee by making observations should communicate with the secretary, Dr. W. Eccles, University College, Gower Street, London, England.

APPLIED SCIENCE IN THE UNIVERSITY OF SHEFFIELD.

ON October 25 the completed buildings of the applied science department of Sheffield University were opened by Lord Haldane. These buildings have the largest frontage in Sheffield, being 350 ft. long, the architecture being of the Hampton Court Palace type. The cost of the additions has been approximately 45,000*l.* The central administrative block contains a very fine assembly-room, called the "Mappin Hall," after the late Sir Frederick Thorpe Mappin, first chairman of the applied science committee of Sheffield University, and a handsome departmental library which will house books having reference to applied science and pure science data more immediately bearing upon this subject. There are staff common-rooms, and the metallurgical record office included in this central block, and the department of pure geology is also housed here.

The south-east wing, a considerable portion of the cost of which was defrayed by the Drapers' Company of London, contains four floors; the two lower floors are devoted to non-ferrous metallurgy, the third floor to mining, and the fourth floor to applied chemistry which has particular reference to mining. The new non-ferrous department, which has been organised so as not in any way to overlap the metallurgy of the Royal School of Mines, has been designed to develop scientifically the silver industries of Sheffield. The course here is divided into two sections: first, the basis metal section, in which are produced on a works' scale ingots of German silver, Britannia metal, brass, and bronze, white metals, and other non-ferrous metals in use in Sheffield manufactures (for working these metals into the finished articles, the department has secured the friendly cooperation of silver manufacturers in Sheffield); secondly, the electroplating department, in which all classes of plating operations are carried on on a manufacturing scale. Each student's bench is fitted with a specially combined ammeter and voltmeter, so that the student may make his preliminary studies under exactly known conditions. There are two large laboratories for the preparatory and advanced stages of this special study of non-ferrous metals as used in the Sheffield trades. The lecture-rooms are two in number, one seating 150 and the other fifty students, both being provided with up-to-date electric lantern arrangements.

The micrographic laboratory has been made to a specially thought out design, each block of the polishing battery being run by a separate electric motor of one-seventh h.p., revolving at 1400 revolutions per minute. Adjacent to the polishing and etching-room is a photomicrographic department complete with dark-room. The photomicrographic apparatus is by Zeiss, and is fitted with the new arc lamp of this firm. There is a large staff and research laboratory, one side of which is devoted to calorimetric work.

From the point of view of pure science the most important installation in the new metallurgical wing is a specially devised recalescence laboratory for observing with great accuracy the critical points of iron and steel, the freezing points of metals, and the phenomena of solid solution in metals. There are coke-fired and electric vacuum furnaces in which a complete vacuum can be obtained in about one minute by means of the "Fleuss" pump. The recalescence apparatus comprises an astronomical clock by the Synchronome Company, a chronographic recorder reading to a quarter of a second, and a delicate galvanometer reading direct or in connection with a potentiometer. This installation, which has been made to specification by the Cambridge Scientific Instrument Co., has cost about 400*l.*, and is the most complete extant.

The melting-shop for non-ferrous metal will register the comparative melting efficiencies of coke, oil, gas, and electricity, each method being capable of making ingots of about 90 lb. weight. The static and dynamic testing of non-ferrous metals will be made in the ferrous department, which is provided with a single-lever Buckton machine on two centres, so that the machine may be arranged to read off the stress either in 3-in. ton moments or 12-in. ton moments. For more delicate work there is a two-ton static machine. The dynamic testing will be carried out on Arnold's standard stress-strain machine, on which it is hoped to obtain important results on the adherence of silverplating of different thicknesses on different basis metals.

In declaring the building open, Lord Haldane insisted most strongly that the industrial success of this country in the future depends upon the cordial cooperation of pure and applied science, which are practically indivisible. He said:—"Without a Kelvin or a Clerk Maxwell, or a Lister, or a man, to go further back, like Sir Isaac Newton, many of the things which we do to-day, and do so well, would not be done, but we have also to remember that unless other men of a similar type are produced in the future we cannot keep up to the level we are now at, but we should be at a disadvantage compared with other countries. You have done a very practical thing in founding this great new department of applied science; you have done the right thing in keeping applied science and pure science in close relation, and bringing both into intimate organic relation with the spirit of the University, that great permeating spirit without which they cannot be on a high level.

"What will be done in the department of applied science will be to go still further than has been possible in the past in bringing the application of science to bear on the problems of industry. It will not be practical work merely; it will be work in the course of which the student will be trained in the highest knowledge. He also will be told that he must not stop short at the conclusions to which science leads him, but must show his capacity to apply the conclusions at which he has arrived to the actual and practical solution of the difficulties which confront the industrial world. In the old days pure science appeared to be something no one was interested in from the point of view of practical education. Now the greatest commercial discoveries depend upon new ideas, new conceptions being developed by men who have genius which makes them devoted to their work, even though they have to starve to do it. It is only in universities and technical schools that we find these men, and if British industry is to hold its own in the future, we shall have to realise the necessity there is, not only to turn to science, but to see that pure science has an opportunity of developing itself and being brought in contact with daily work."

Lord Haldane went on to contrast the rapid strides that are being made in the development of universities in America with what is being done in this country. He has, he said, great faith in the capacity of the British nation, but unless we wake up thoroughly in the matter of education, and particularly higher education, he is a little nervous as to what we may find the state of things concerning our industrial supremacy some fifteen or twenty years hence.

"Nowadays not only Governments, but Government Departments are waking up about these things. For the last twelve months there has been a great deal of activity about the business of national education. Mr. Pease is carrying out what I believe to be a right line of policy. He is trusting the very highly expert officials at the Board of Education and consulting the education committees throughout the country. The local education committees have done splendid work, but the burden on them has been very heavy. The nation will have to make up its mind to give considerably more out of the taxes for this work. The plans are now fashioned. The Government knows exactly what to do to make advance if only it has the nation at its back. I hate any idea of increasing expenditure, whether it is out of local or national resources, if it can be avoided. This expenditure, however, cannot be avoided. Unless we spend it we shall go back as a nation. Our revenues, by which we keep up our fleets and armies, will shrink, because we shall not be holding our own with the industrial nations. What Sheffield has done will have to be done right through the country."

Lord Haldane also referred to the report of the Advisory Committee on University Grants, and mentioned that this Committee, amongst other matters, has practically decided recently to deal with a pension fund for professors (see Nature, March 6, 1913, p. 21), which, he said, "meant that instead of a man having to cling on to his post as the alternative to starving when he felt himself old, he could retire, and let a young man take his place, and go on with the development still further of the teaching which the professor had carried so far."

THE BRITISH ASSOCIATION AT BIRMINGHAM.

SECTION M.

AGRICULTURE.

Opening Address by Prof. T. B. Wood, President of the Section.

I propose to follow the example of my predecessor of last year, in that the remarks I wish to make to-day have to deal with the history of agriculture. Unlike Mr. Middleton, however, whose survey of the subject went back almost to prehistoric times, I propose to confine myself to the last quarter of a century—a period which covers what I may perhaps be permitted to call the revival of agricultural science.

Twenty-five years ago institutions concerned with the teaching of agriculture or the investigation of agricultural problems were few and far between. I do not propose to waste time in giving an exhaustive list, nor would such a list help me in developing the argument I wish to lay before the section. It will serve my purpose to mention that organised instruction in agriculture and the allied sciences was already at that date being given at the University of Edinburgh and at the Royal Agricultural College, whilst, in addition, one or more old endowments at other universities provided courses of lectures from time to time on subjects related to rural economy. Agricultural research had been in progress for fifty years at the Rothamsted Experimental Station, where the work of Lawes and Gilbert had settled for all time the fundamental principles of crop production. Investigations of a more practical nature had also been commenced by the leading agricultural societies and by more than one private landowner.

In these few sentences I have endeavoured to give a rough, but for my purpose sufficient, outline of the facilities for the study of agricultural science twenty-five years ago, at the time when the county councils were created. Their creation was followed almost immediately by what can only be called a stroke of luck for agriculture. The Chancellor of the Exchequer found himself with a considerable sum of money at his disposal, and this was voted by Parliament to the newly created county councils for the provision of technical instruction in agriculture and other industries.

Farmers were at that time struggling with the bad times following the wet seasons and low prices of the 'seventies and 'eighties, and some of the technical instruction grant was devoted to their assistance by the county councils, who provided technical instruction in agriculture. Thus, for the first time considerable sums provided by the Government were available for the furtherance of agricultural science; and, although at first there was no general plan of working and every county was a law unto itself, the result has been a great increase of facilities for agricultural education and research.

Almost every county has taken some part. The larger and richer counties have founded agricultural institutions of their own. In some cases groups of counties have joined together and federated themselves with established teaching institutions. For my purpose it suffices to state, without going into detail, that in practically every county, in one way or other, attempts have been made to carry out investigations of problems related to agriculture.

Twenty years after the voting of the technical instruction grant to the county councils, Parliament has again subsidised agriculture, in the shape of the Development Fund, by means of which large sums of money have been devoted to what may be broadly called agricultural science. It seems to me that the advent of this second subsidy is an occasion when this section may well pause to take stock of the results which have been achieved by the expenditure of the technical education grant. I do not propose to discuss the results achieved in the way of education, although most of the technical instruction grant has been spent in that direction. It will be more to the point in addressing the Agricultural Section to discuss the results obtained by research.

The subject, then, of my address is the result of the last twenty years of agricultural research, and I propose to discuss both successes and failures, in the hope of arriving at conclusions which may be of use in the future.

Agricultural science embraces a variety of subjects. I propose to consider first the results which have been obtained by the numerous practical field experiments which have been carried out in almost every county. I suppose that the most striking result of these during the last twenty years is the demonstration that in certain cases phosphates are capable of making a very great increase in the crop of hay, and a still greater increase in the feeding value of pastures. This increase is not yielded in all cases, but the subject has been widely investigated, and the advisory staffs of the colleges are in a position to give inquirers trustworthy information as to the probability of success in almost any case which may be submitted to them. This is a satisfactory state of things, and the question naturally arises: How has it come about?

On looking through the figures of the numerous reports which have been published on this subject, it appears at once that in many cases the increase in live-weight of sheep fed on plots manured with a suitable dressing of phosphate has been twice as great as the increase in weight of similar animals fed on plots to which phosphate has not been applied. Now about a difference of this magnitude between two plots there can be no mistake. It has been shown by more than one experimenter that two plots treated similarly in every way are as likely as not to differ in production from their mean by 5 per cent. of their produce, and this may be taken as the probable error of a single plot. Where, as in the case of many of the phosphate experiments, a difference of 100 per cent. is recorded, a difference of twenty times the probable error, the chances amount to a certainty that the difference is not an accidental variation, but a real effect of the different treatment of the two plots. The single-plot method of conducting field trials, which is the one most commonly used, is evidently a satisfactory method of measuring the effects of manures which are capable of producing 100 per cent. increases. It was good enough to demonstrate with certainty the effects of phosphatic manuring on many kinds of grass land, and it is to this fact that we owe one of the most notable achievements of agricultural science in recent years.

Another notable achievement is the discovery that in the case of most of the large-cropping varieties of potatoes the use of seed from certain districts in Scotland or the northern counties of Ireland is profitable. This is another instance of an increase large enough to be measured accurately by the single-plot method. Reports on the subject show that seed brought recently from Scotland or Ireland gives increased yields of from 30 to 50 per cent. over the yields produced by seed grown locally for three or more years.

That the single-plot method fails to give definite results in many cases where it has been used for manurial trials is a matter of common knowledge. Half the reports of such trials consist of explanations of the discrepancies between the results obtained and the results which ought to have been obtained. The moral is obvious. The single-plot method, which suffices to demonstrate results as striking as those given by phosphates on some kinds of pasture land, signally fails when the subject of investigation is concerned with differences of 10 per cent. or thereabouts.

Before suggesting a remedy for this state of things it will be well to consider the allied subject of variety testing, which has been brought into great prominence recently by the introduction of new varieties of many kinds of farm crops. In testing a new variety it is necessary to measure two properties—its quality and its yielding capacity—for money-return per acre is obviously determined by the product of yielding capacity and quality as expressed by market price. I propose here to deal only with the determination of yielding capacity. The determination of quality is not allied to manurial trials.

In attempting to determine yielding capacity there has always been a strong temptation to rely on the measurement of obvious structural characters. For instance, in the case of cereals many farmers like large ears, no doubt with the idea that they are an indication of high-yielding capacity. Many very elaborate series of selections have been carried out, on the assumption that large grains, or large ears, or many ears per plant implied high yield.

We may take it as definitely settled that none of these characters is trustworthy, and that the determination of yielding capacity resolves itself into the measurement of the yield given by a definite area. The actual measurement, therefore, is the same as that made in manurial trials, and is, of course, subject to the same probable error of about 5 per cent.

It follows, therefore, that it is subject to the same limitations. Variety trials on single plots, and that is the method commonly used, will serve to measure variations in yielding capacity of 30 per cent., or more, but are totally inadequate to distinguish between varieties the yielding capacities of which are within 10 per cent. of each other.

Numbers of such single-plot trials have been carried out, with the result that many varieties with yielding capacities much below normal have almost disappeared from cultivation, and those commonly grown do not differ greatly from one another—probably not more than 10 per cent.

Ten per cent. in yielding capacity, however, in cereals means a return of something like 15*s.* to 20*s.* per acre—a sum which may make the difference between profit and loss; and if progress is to be made in manuring and variety testing, some method must be adopted which is capable of measuring accurately differences in yield per unit area of the order of 10 per cent.

The only way of decreasing the probable error is to increase the number of plots, and to arrange them so that plots between which direct comparison is necessary are placed side by side, so as to reduce as much as possible variations due to differences in soil. Thus it has been shown that with ten plots in five pairs the probable error on the average can be reduced to about 1 per cent., in which case a difference of from 5 to 10 per cent. can be measured with considerable certainty.

Such a method involves, of course, a great deal of trouble; but agricultural science has now reached that stage of development at which the obvious facts which can be demonstrated without considerable effort have been demonstrated, and further knowledge can only be acquired by the expenditure of continually increasing effort. In fact, the law of diminishing return holds here, as elsewhere.

It appears, then, that for questions involving measurements of yield per unit area, such, for instance, as manurial or variety trials, further advance is not likely to be made without the expenditure of much more care than has been given to such work in the past. The question naturally arises: Is it worth while? I think the following instance shows that it is:—

Some years ago an extensive series of variety trials was carried out in Norfolk, in which several of the more popular varieties of barley were grown side by side at several stations for several seasons. In all, the trial was repeated eleven times. As a final result it was found that Archer's stiff-straw barley gave 10 per cent. greater yield than any other variety included in the trials, and by repetition of the experiment the probable error was reduced to 1½ per cent. The greater yield of 10 per cent., being over six times the probable error of the experiment, indicates practical certainty that Archer barley may be relied on to give a larger crop than any of the other varieties with which it was compared. One difficulty still remained. It was almost impossible to obtain anything like a pure strain of Archer barley. Samples of Archer sold for seed commonly contained 25 per cent. of other varieties. This difficulty was removed by Mr. Beaven, who selected, again with enormous trouble, a pure high-yielding strain of Archer barley. Since this strain was introduced into the Eastern Counties the demand for it has always exceeded the supply which could be grown at Cambridge and at the Norfolk Agricultural Station, and it is regarded by farmers generally as a very great success.

The conclusion, therefore, is that a 10 per cent. difference is well worth measuring, that it cannot be measured with certainty by the single-plot method, and that it behoves those of us who are concerned with field trials to look to our methods, and to avoid printing figures for single-plot experiments which may very well be misleading. Almost everyone thinks himself competent to criticise the farmer, who is commonly described as too self-satisfied to acquaint himself with new discoveries, and too conservative to try them when they are brought to his notice. Let us examine the real facts of the case. Does the farmer ignore new discoveries? The largely increasing practice of consulting the staffs of the agricultural colleges, which has arisen among farmers during the last few years, conclusively shows that he does not; that he is, in fact, perfectly ready to avail himself of sound advice whenever he can. Is he too conservative to try new discoveries when brought to his notice? The extraordinary demand for seed of the new Archer barley quoted above, and for seed of new varieties generally, the continuous advance in the prices of phosphatic manures, as the result of increased demand by farmers, the trade in Scotch and Irish seed potatoes, all show how ready the farmer is to try new things. The chief danger seems to be that he tries new things simply because they are new, and he may be disappointed if those who are responsible for the new things in question have not taken pains to ascertain with certainty that they are not only new but good. Farmers are nowadays in what may be called a very receptive condition. Witness the avidity with which they paid extravagant prices for single tubers of so-called new, but inadequately tested, varieties of potatoes some years ago, and in a less degree the extraordinary demand for seed of the much-boomed French wheats, and the excitement about nitragin for soil or seed inoculation. Witness, too, the almost universal failure of the new potatoes and French wheats introduced during the boom, and the few cases in which nitragin gave any appreciable result. The farmer who was disappointed with his ten-guinea tuber, his expensive French wheat, or his culture of nitragin cannot but be disillusioned. Once bitten, twice shy. He does not readily take advice again.

Let us, therefore, recognise that the farmers of the country are ready to listen to us, and to try our recommendations, and let that very fact bring home to us a sense of our responsibility. All that is new is not, therefore, necessarily good. Before we recommend a new thing let us take pains to assure ourselves of its goodness. To do so we must find not only that the new thing produces a greater return per acre, but that the increased return is worth more than it costs to produce, and we must also define the area or the type of soil to which this result is applicable. This implies in practice that each field trial should confine itself to the investigation of only one, or, at most, two, definite points, since five pairs of plots will be required to settle each point; that the experimental results should be reviewed in the light of a thorough knowledge of farm book-keeping, and that accurate notes should be taken of the type of the soil, and the area to which it extends, and of the various meteorological factors which make up the local climate. At present we are not in possession of a sufficient knowledge of farm accountancy, but there is hope that this deficiency will be removed by the work of the Institute for Research in Agricultural Economics, which has recently been founded at Oxford by the Board of Agriculture and the Development Commission. The excellent example set by Hall and Russell in their "Survey of the Soils and Agriculture of the South-Eastern Counties," an example which is being followed in Cambridge and elsewhere, seems likely to result in the near future in a complete survey of the soils of England which will make a sound scientific basis for delimiting the areas over which the results of manurial or variety trials are applicable.

Reviewing this branch of agricultural science, the outlook is distinctly hopeful. New fertilisers are coming into the market, as, for instance, the various products made from atmospheric nitrogen. New varieties of farm crops are being produced by the Plant-breeding Institute at Cambridge, and elsewhere. It is to be hoped that the work of the Agricultural Economics Institute at Oxford will throw new light on the interpretation of experimental results from the accountancy standpoint. Finally, the soil surveys on which the colleges have seriously embarked will assist in defining the areas over which such results are applicable. It only remains for those of us who are responsible for the conduct of field trials to increase the accuracy of our results, and the steady accumulation of a mass of systematic and scientific knowledge is assured. It will be the business of the advisory staffs with which the colleges have recently been equipped by the Board of Agriculture and the Development Commission to disseminate this knowledge in practicable form to the farmers of this country.

One more point, and I have finished this section of my address. I have perhaps inveighed rather strongly against the publication of the results of single-plot trials. I quite recognise that the publication of such results was to a great extent forced upon those experimenters who were financed by annually renewed grants of public money. Nowadays, however, agricultural science is in a stronger position, and I venture to hope that most public authorities which subsidise such work are sufficiently alive to the evils attendant on the publication of inconclusive results to agree to continue their grants for such periods as may suffice for the complete working out of the problem under investigation, and to allow the final conclusions to be published in some properly accredited agricultural journal, where they would be readily and permanently available to all concerned. This would in no wise prevent their subsequent incorporation in bulletins specially written for the use of the practical farmer.

So far I have confined my remarks to subjects of which I presume that every member of the section has practical experience, subjects which depend on the measurement of the yield per unit area. These subjects, however, although they have received far more general attention than anything else, by no means comprise the whole of agricultural science. Certain scientific workers have confined their efforts to the thorough solution of specific and circumscribed problems. I propose now to ask the section to direct its attention to some typical results which have been thus achieved during the last twenty years.

The first of these is the development of what I may call soil science. Twenty years ago the bacteriology of nitrification had just been worked out by Warington and by Winogradski. The phenomena of ammoniacal fermentation of organic matter in the soil were also fairly well established. The fixation of atmospheric nitrogen by organisms symbiotic on the leguminosæ had been definitely demonstrated. Fixation of nitrogen by free-living organisms had been suggested, but was still strenuously denied by most soil investigators. No suggestion had yet been made of the presence in normal soils of any factor which inhibited crop production. The last twenty years have seen a wonderful advance in soil science. Our knowledge of nitrification and ammoniacal fermentation has been much extended. The part played by the nodule organisms of the leguminosæ has been well worked out, has seen a newspaper boom, and a subsequent collapse, from which it has not yet recovered. But the greatest advance has been the discovery of the part played by protozoa in the inhibition of fertility.

The suggestion that ordinary soils contained a factor which limited their fertility emanated in the first instance from the American Bureau of Soils. The factor was at first thought to be chemical, and its presence was tentatively attributed to root excretion. Certain organic substances, presumably having this origin, have been isolated from sterile soils, and found to retard plant growth in water-culture. It is claimed, too, that the retardation they cause is prevented by the presence of many ordinary manurial salts with which they are supposed to form some kind of combination.

Contributions to the subject have come from several quarters, but whilst the suggested presence of an inhibitory factor has been generally confirmed, its origin as a root-excretion and its prevention by manurial salts has not received general confirmation outside American official circles. The matter has been strikingly cleared up by the work of Russell and Hutchinson at Rothamsted, who observed that the fertility of certain soils which had become sterile was at once restored by partial sterilisation, either by heating to a temperature below 100° C., or by the use of volatile antiseptics such as toluene. This observation suggested that the factor causing sterility in these cases was biological in nature, that it consisted, in fact, of some kind of organism inimical to the useful fermentation bacteria, and more easily killed than they by heat or antiseptics. After a long series of admirable scientific investigations these workers and their colleagues have shown that soils contain many species of protozoa, which prey upon the soil bacteria, whose numbers they keep within definite limits. In certain circumstances, such, for instance, as those existing in the soil of sewage farms, and in the artificial soils used for the cultivation of cucumbers, tomatoes, &c., under glass, the protozoa increase so that the bacteria are reduced below the numbers requisite to decompose the organic matter in the soil into substances suitable for absorption by the roots of the crop. Practical trials of heating such soils, or subjecting them to the action of toluene, or other volatile antiseptics, have shown that their lost efficiency can thus be easily restored, and the method is now rapidly spreading among the market gardeners of the Lea Valley.

I have attempted to sketch the chief points of this subject with some detail in order to show that strictly scientific work, quite outside the scope of what some people still regard as "practical," may result in discoveries which, apart from their great academic interest, may at once be turned to account by the cultivator. The constant renewal of expensively prepared soil which becomes "sick" in the course of a year or so is a serious item in the cost of growing cucumbers and tomatoes. It can now be restored to fertility by partial sterilisation at a fraction of the cost of renewal, and considerable sums are thus saved by the Lea Valley growers.

For my second instance of scientific work which has given results of direct value to farmers, I must ask to be allowed to give a short outline of the wheat-breeding investigations of my colleague Prof. Biffen. Even as late as fifteen years ago plant-breeding was in the purely empirical haphazard stage. Then came the rediscovery of Mendel's laws of heredity, which put in the hands of breeders an entirely new weapon. About the same time the Millers' Association created the Home-grown Wheat Committee, of which Biffen was a member. Through this committee he was able to define his problem as far as the improvement of English wheat was concerned. There appeared to be two desiderata: (1) The production of a wheat which would crop as well as the best standard home-grown varieties, at the same time yielding strong grain, *i.e.* grain of good milling and baking quality; and (2) the production of varieties of wheat resistant to yellow rust, a disease which has been computed to decrease the wheat crop of the world by about one-third.

The problem having been defined, samples of wheat were collected from every part of the world and sown on small plots. From the first year's crop single ears were picked out and grown on again. Thus several hundred pure strains were obtained. Many were obviously worthless. A few possessed one or more valuable characteristics: strong grain, freedom from rust, sturdy straw, and so on. These were used as parents for crossing, and from the progeny two new varieties have been grown on, thoroughly tested, and finally put on the market. Both have succeeded, but both have their limitations. Burgoyne's Fife, which came from a cross between strains isolated respectively from Canadian Red Fife and Rough Chaff, was distributed by the Millers' Association after a series of about forty tests, in which it gave an average crop of forty bushels per acre of grain, which milled and baked practically as well as the best imported Canadian wheat. It is an early-ripening variety which may even be sown as a spring wheat. It has repeatedly been awarded prizes for the best sample of wheat at shows, but it only succeeds in certain districts. It is widely and successfully grown in Bedfordshire and Dorset, but has not done well in Norfolk. The other variety, Little Joss, succeeds much more generally. In a series of twenty-nine trials scattered between Norfolk and Shropshire, Kent and Scotland, it gave an average of forty-four bushels per acre, as compared with forty bushels given by adjoining plots of Square Head's Master. It originated from a cross between Square Head's Master and a strain isolated from a Russian graded wheat known as Ghirka. Its grain is the quality of ordinary English wheat. It tillers exceptionally well in spring, and is practically rust-proof. Its one drawback is its slow growth during the winter if sown at all late. It has met with its greatest success in the Fen districts, where rust is more than usually virulent.

The importance of this work is not to be measured only by the readiness with which the seed of the new varieties has been tried by farmers and the extent to which it has succeeded. The demonstration of the inheritance of immunity to the disease known as yellow rust, the first really accurate contribution to the inheritance of resistance to any kind of disease, inspires hope that a new method has appeared for the prevention of diseases in general.

Biffen's work too shows the enormous value of co-operation between the investigator and the buyer in defining problems connected with the improvement of agricultural produce. It is open to doubt if a committee of farmers would have been able to define the problems of English wheat production as was done by the Millers' Committee, and in the solution of any problem its exact definition is half the battle. Mackenzie and Marshall in their work on the "Pigmentation of Bacon Fat" and on the spaying of sows for fattening, have found the great value of consultation with the staffs of several large bacon factories. There seems to be in this a general lesson that before taking up any problem one should get into touch not only with the producers but with the buyers, from whom much useful information can be obtained.

I feel that Biffen's work has borne fruit in still another direction, for which perhaps he is not alone responsible. Twenty years ago agricultural botany took a very subsidiary position in such agricultural examinations as then existed. In some of the agricultural teaching institutions there was no botanist, in others the botanist was only a junior assistant. It is largely due to the work of Biffen and the botanists at other agricultural centres that botany is now regarded as perhaps the most important science allied to agriculture.

I must here repeat that I am not attempting to make a complete survey of all the results obtained in the last twenty years. My object is only to pick out some of the typical successes and failures and to endeavour to draw from their consideration useful lessons for the future. So far I have not referred to the work which has been done in the nutrition of animals, and I now propose to conclude with a short discussion of that subject. The work on that subject which has been carried out in Great Britain during the last twenty years has been almost entirely confined to practical feeding trials of various foods or mixtures of foods, trials which have been for the most part inconclusive.

It has been shown recently that if a number of animals in store condition are put on a fattening diet, at the end of a feeding period of twelve to twenty weeks about half of them will show live-weight increases differing by about 14 per cent. from the average live-weight increase of the whole lot. In other words, the probable error of the live-weight increase of a single fattening ox or sheep is 14 per cent. of the live-weight increase. This being so, it is obvious that very large numbers of animals must be employed in any feeding experiment which is designed to compare the feeding value of two rations with reasonable accuracy. For instance, to measure a difference of 10 per cent. it is necessary to reduce the probable error to 3 per cent. in order that the 10 per cent. difference may have a certainty of thirty to one. To achieve this, twenty-five animals must be fed on each ration. Those conversant with the numerous reports of feeding trials which have been published in the last twenty years will agree that in very few cases have such numbers been used. We must admit then that many of the feeding trials which have been carried out can lay no claim to accuracy. Nevertheless, they have served a very useful purpose. From time to time new articles of food come on the market, and are viewed with suspicion by the farmers. These have been included in feeding trials and found to be safe or otherwise, a piece of most useful information. Thus, for instance, Bombay cotton cake, when first put on the market, was thought to be dangerous on account of its woolly appearance. It was tried, however, by several of the agricultural colleges and found to be quite harmless to cattle. Its composition is practically the same as that of Egyptian cotton cake, and it now makes on the market practically the same price.

Soya-bean cake is another instance of a new food which has been similarly tested, and found to be safe for cattle if used in rather small quantities and mixed with cotton cake. The price is now rapidly rising to that indicated by its analysis. Work of this kind is, and always will be, most useful. Trials with few animals, whilst they cannot measure accurately the feeding value of a new food, are quite good enough to demonstrate its general properties, and its price will then gradually settle itself as the food gets known.

Turning to the more strictly scientific aspects of animal nutrition, entirely new ideas have arisen during the last twenty years. I propose to discuss these shortly, beginning with the proteins. Twenty years ago the generally accepted view of the *rôle* of proteins in nutrition was that the proteins ingested were transformed in the stomach and gut into peptones, and absorbed as such without further change. Splitting into crystalline products, such as leucin and tyrosin, was thought only to take place when the supply of ingested protein exceeded the demand, and peptones remained in the gut for some time unabsorbed. It is now generally agreed that ingested protein is normally split into crystalline products which are separately absorbed from the gut, and built up again into the various proteins required by the animal. If the ingested protein does not yield a mixture of crystalline products in the right proportions to build up the proteins required, those crystalline products which are in excess are further changed and excreted. If the mixture contains none of one of the products required by the animal, then life cannot be maintained. This has been actually demonstrated in the case of zein, one of the proteins of maize, which contains no tryptophane. The addition of a trace of tryptophane to a diet, in which zein was the only protein, markedly increased the survival period of mice.

The adoption of this view emphasises the importance of a knowledge of the composition of the proteins, and especially of a quantitative knowledge of their splitting products, and much work is being directed to this subject in Germany, in America, and more recently in Cambridge as a result of the creation there of an institute for research in animal nutrition by the Board of Agriculture and the Development Commission. This work is expected ultimately to provide a scientific basis for the compounding of rations, the idea being to combine foods the proteins of which are, so to speak, complementary to each other, one giving on digestion much of the products of which the other gives little. Meantime, it is desirable that information should be collected as to mixtures of foods which are particularly successful or the reverse.

Here the question arises, for what purpose does the animal require a peculiarly complicated substance like tryptophane? The natural suggestion seems to be that the tryptophane grouping is required for the building up of animal proteins. It has also been suggested that such substances are required for the formation of hormones, the active principles of the internal secretions the importance of which in the animal economy has received such ample demonstration in recent years. The importance of even mere traces of various substances in the animal economy is another quite recent conception. Thus it has been shown, both in Cambridge and in America, that young animals fail to grow on a diet of carefully purified casein, starch, fat, and ash, although they will remain alive for long periods. In animals on such a diet, however, normal growth is at once started by the addition of a few drops of milk or meat juice, or a trace of yeast, or other fresh animal or vegetable matter. The amount added is far too small to affect the actual nutritive value of the diet. Its effect can only be due to the presence of a trace of some substance which acts, so to speak, as the hormone of growth. The search for such a substance is now being actively prosecuted. Its discovery will be of the greatest scientific and practical interest.

Evidently new ideas are not lacking amongst those who are engaged in investigating the *rôle* of the proteins and their splitting products in the animal economy. But of more immediate practical interest is the question of the amount of protein required by animals under various conditions. It is obviously impossible to fix this amount with any great accuracy, since proteins differ so widely in composition, but from many experiments, in which a nitrogen balance between the ingesta and the excreta was made, it appears that oxen remain in nitrogenous equilibrium on a ration containing about one pound of protein per 1000 lb. live-weight per day. All the British experiments of a more practical nature have been recalculated on a systematic basis by Ingle, and tabulated in the Journal of the Highland and Agricultural Society. From them it appears that increase of protein in the ration, beyond somewhere between one and a half and two pounds per 1000 lb. live-weight per day of digestible protein, ceases to have any direct influence on increase in live-weight.

We may fairly conclude, then, that about two pounds of proteins per 1000 lb. live-weight per day is sufficient for a fattening ox. This amount is repeatedly exceeded in most of the districts where beef production is a staple industry, the idea being to produce farmyard manure rich in nitrogen. The economy of this method of augmenting the fertility of the land is very doubtful. The question is one of those for the solution of which a combination of accurate experiment and modern accountancy is required. Protein is the most expensive constituent of an animal's dietary. If the scientific investigator, from a study of the quantitative composition of the proteins of the common farm foods, and the economist, from careful dissection of farm accounts, can fix an authoritative standard for the amounts of protein required per 1000 lb. live-weight per day for various types of animals, a great step will have been made towards making mutton and beef production profitable apart from corn-growing.

For many years it has been recognised that an animal requires not only so much protein per day, but a certain quota of energy, and many attempts have been made to express this fact in intelligible terms. Most of them have taken as basis the expression of the value of all the constituents of the diet in terms of starch, the sum of all the values being called the starch equivalent. This term is used by various writers in so many different senses that confusion has often arisen, and this has militated against its general acceptance. Perhaps the most usual sense in which the term is used is that in which it means the sum of the digestible protein multiplied by a factor (usually 0·94) plus the digestible fat multiplied by a factor (usually 2·3), plus the digestible carbohydrates. This, however, gives misleading values which are too high in concentrated foods and too low in bulky foods, the discrepancy being due to the larger proportion of the energy of the bulky foods which is used up in the much greater work of digestion which they require. Kellner and his school have devised a method which measures the starch equivalent by experiment, a much more satisfactory and practical method than any system which depends purely on calculation.

An animal or a number of animals are kept on a maintenance diet so that their weight remains constant. To this diet is added a known weight of starch, and the increase in weight observed. The animal or animals are then placed again on the same maintenance diet for some time, and then a known weight of the food to be tested is added, and the increase in weight again observed. The data thus obtained indicate that so many pounds of starch produce as much increase in live-weight as so many pounds of the food under experiment, from which it is easy to calculate how many pounds of starch are actually required to produce as much increase in live-weight as 100 lb. of the food under experiment. The starch equivalent thus found expresses an experimentally determined fact which is of immediate practical value in arranging a dietary, its value, however, depending on the accuracy with which it has been determined. Kellner and his colleagues have thus determined the starch equivalents of all the commonly used foods. Their values for concentrated foods, and other foods commonly used in Germany, have been determined with considerable accuracy, and with the method which has also been devised for defining the relation between the experimentally determined equivalent and the equivalent calculated from the analysis by means of a formula, they form by far the most trustworthy basis for arranging a feeding ration including such kinds of foods.

But roots, which form the staple of the diet of fattening animals in Great Britain, are not used on the same scale in Germany, and Kellner's starch equivalents for roots have not been determined with sufficient accuracy or under suitable conditions to warrant their use for arranging diets under our conditions.

This, and the fact that the term starch equivalent is so widely misunderstood, is no doubt the reason why the Kellner equivalent has not been more generally accepted in Great Britain. An advance will be made in the practice of feeding as soon as the starch equivalent of roots has been accurately determined under our conditions, when the Kellner equivalents will no doubt come into general use.

I have now reached the end of my survey. I recognise that it is very incomplete, and that I have been compelled to neglect whole subjects in which important work has been done. I venture to hope, however, that my words have not been altogether unprofitable. It is somewhat difficult to summarise what is in itself really nothing but a summary. Perhaps, however, I may be allowed to point out once more what appears to me to be the moral of the last twenty years of work in agricultural science.

The many practical field and feeding tests carried out all over the country have demonstrated several very striking results; but, if they are to be continued with profit, more trouble must be taken to insure accuracy. Farmers are ready to listen. It behoves us more than ever to found what we tell them on accurate results.

Besides such practical trials, however, much has been done in the way of individual scientific work. The results thus obtained, as, for instance, Russell and Hutchinson's partial sterilisation of soils, Biffen's new wheats, and Beaven's pure Archer barley, are of practical value to the farmer as immediate as the most practical field trial, and of far wider application.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The Herbert Spencer lecture will be delivered by Prof. C. Lloyd Morgan, F.R.S., professor of psychology in the University of Bristol, on Friday, November 7. The subject of the lecture will be:—"Spencer's Philosophy of Science."

Dr. O. W. Richardson, F.R.S., professor of physics in Princeton University, New Jersey, has been appointed as from January 1 next to the Wheatstone chair of physics at King's College, London, in succession to Prof. C. G. Barkla, F.R.S.

Mrs. W. Bayard Cutting and her children have (says *Science*) given 40,000*l.* to Columbia University for a fund in memory of the late W. Bayard Cutting, who served as trustee of the University from 1880 until his death, in 1912. The income of this fund is to be applied to the maintenance of travelling fellowships, open to graduate students of distinction in letters, science, law, and medicine or engineering.

Students who are working privately with the object of graduating in the University of London will welcome the "London University Guide and University Correspondence College Calendar, 1914," published by the University Correspondence College, London, and distributed gratuitously. The first part of the volume constitutes the guide, and contains the regulations for the examinations leading to the various degrees to be held by the University of London in 1914 and 1915. The calendar, 1913–14, which completes the volume, gives particulars of the facilities offered by the University Correspondence College to students who desire assistance in their work through the post.

A very useful form of pocket diary, which covers the academic year beginning with October, 1913, instead of commencing with January in the usual way, has been published by the Cambridge University Press. Though concerned more particularly with events in the work of the University of Cambridge, the diary will appeal to all whose work is in connection with colleges or schools. The diary is published in three forms, at 1*s.* net, 2*s.* net, and 2*s.* 6*d.* net respectively. From the same source we have received "The Cambridge Diary for the Academical Year 1913–14," in block form. Each sheet contains seven days, and ample space is provided for manuscript notes of engagements. The price of this diary is 1*s.* net.

The establishment of new universities in Germany was one of the chief topics of discussion at the recent congress of German university teachers held at Strasburg. The movement was strongly opposed in a report presented by Prof. Bücher, of Leipzig. According to this, many corporations, with the encouragement of the Ministry are endeavouring to raise the status of existing institutions to that of university rank. The preponderance of government in such institutions would be municipal, and consequently university independence would be endangered, and, in addition, a high academic standard would not be maintained. Overcrowding of the existing universities was advanced as an argument in favour of the creation of new institutions, but the organisation of such universities as those of Berlin and Leipzig enabled them to deal with large numbers without any detriment to the teaching. Prof. Kaufmann, of Breslau, remarked that quite 40 per cent. of the students were unsuited for an academic training, and the creation of new institutions would in no way relieve overcrowding at the older universities, but simply increase the total number of students. Many teachers, however, were strongly in favour of the movement, contending that the establishment of universities in the large industrial and commercial centres was an essential and necessary element in modern conditions of life. It was a movement which should be strenuously supported. Side by side with this question arose that of the standard required for the doctorate. The congress considered it should be made imperative for all universities to demand a thesis embodying independent and original research work from the candidate.

THE second annual report of the King Edward VII. British-German Foundation states that there is an increase in the expenditure, due to a larger number of cases assisted, and to the fact that several of the permanent allowances have been raised. We learn from *The Times* that in accordance with the terms of the trust deed, which provides for an annual joint sitting of the two sections of the foundation, alternately in England and Germany, the first joint conference was held last September, at Sir Ernest Cassel's residence in London. The question of the best way of employing the surplus funds was discussed, and it was agreed finally to adopt the following resolution:—"That a certain proportion of the surplus funds of the German section be employed in enabling British subjects to attend or visit universities, schools, institutes, or business establishments in Germany, or to reside in Germany, and that a certain proportion of the surplus funds of the British section be employed in enabling Germans to attend or visit universities, schools, institutes, or business establishments in the United Kingdom, or to reside in the United Kingdom." It is hoped that this scheme will serve to assist students who are not possessed of the necessary means in pursuing a course of studies abroad, and give them an insight into the customs and character of the German people, affording them an opportunity of making lasting friendships with Germans, and thus help in promoting a good understanding between the two nations. The second joint conference of the two sections was held in Berlin on October 25. Its main object was to discuss the merits of the scheme of studentships and the desirability of continuing it.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 20.—M. F. Guyon in the chair.—Pierre **Termier**: The A1 excursion of the twelfth International Geological Congress: the Appalachian region of Canada.—R. **Lépine** and M. **Boulud**: The presence, in the vascular walls, of a ferment setting free a reducing sugar at the expense of the virtual sugar of the blood, and capable of hydrolysing phloridzin. These experiments show that the vascular walls possess a new function, hitherto ascribed to the liver alone.—Léon **Lichtenstein**: Some applications of the notions of functions of an infinity of variables in the calculus of variations.—François **Lukács**: Laplace's series.—Pierre **Idrac**: Experimental researches on the *vol plané*. Photographic experiments with small balloons show that in places where birds are capable of hovering flight there is an ascending current of air with velocities of the order of 3 to 4 metres per second. This corresponds to the magnitude of the velocity of air currents in the *vol plané* of an aëroplane.—R. **Fortrat**: An abnormal Zeeman phenomenon with the sodium doublet, $\lambda = 2853$. The use of a ferro-cobalt electromagnet, made according to the indications of P. Weiss, enabled the author to place an ordinary spark in a field of 49400 Gauss. The experimental results obtained agree closely with the theory of Voigt.—Raoul **Dupuy**: Functional arterial hypertensions. Pseudo-arterio-sclerosis. A discussion of the means of differentiating arterio-sclerosis from functional hypertension.—P. **Chaussé**: The path of penetration of the tuberculous virus in the calf and the tuberculigenic power of cow's milk. Inhalation is the usual mode of tuberculous infection in the young calf; intra-uterine infection must also be taken into consideration, since the latter furnishes an important proportion of the graver cases. Although the calf is much more exposed than the adult animal to infection through the alimentary canal, this is relatively the least important mode of infection. The milk of the cow is not the cause of infection of the calf to any great extent.—J. **Danysz**: The use of some new medicinal combinations in the treatment of trypanosomiasis. A compound obtained by the action of silver nitrate upon arsenobenzene, was found capable of sterilising the blood of rabbits infected with Surra by a single injection. *Trypanosoma rhodesiense* was more resistant but succumbed to a mixture of the above reagent with trypan red.—Jules **Amar**: The physiological effects of work and the degree of fatigue.—R. **Anthony**: The experimental study of the factors determining the cranial morphology of mammals deprived of teeth.—J. **Chaine**: The *îlots* of the Termites.—M. **Lemoigne**: The butylene-glycollic fermentation of glucose by staphylococci.—Lucien **Mayet** and Jean **Pissot**: The discovery of the engraved bone of a mammoth showing a human figure, in the upper Aurignacian layer of La Colombière, near Poncin. The drawing described would appear to be the first engraving of man of the middle Quaternary epoch.—Jean **Boussac**: The geological constitution of Haute-Tarentaise.—F. **Dienert**: Remarks concerning some experiments with fluorescin.

BOOKS RECEIVED.

Records of the Indian Museum. Vol. viii., Zoological Results of the Abor Expedition, 1911–12. Part 3. September. Pp. 191–231 + plates. (Calcutta.) 2 rupees.

Memoirs of the Indian Museum. Vol iv., No. 1, An Account of the Crustacea Stomatopoda of the Indo-Pacific Region, based on the Collection in the Indian Museum. By S. Kemp. Pp. 217 + plates. (Calcutta.) 15 rupees.

Über Natronzellstoff: seine Herstellung und chemischen Eigenschaften. By Dr. C. Christiansen. Pp. v + 154. (Berlin: Gebrüder Borntraeger.) 5 marks.

Einführung in die Mykologie der Gebrauchs- und Abwässer. By Dr. A. Kossowicz. Pp. vi + 222. (Berlin: Gebrüder Borntraeger.) 6.60 marks.

Handbuch der Morphologie der Wirbellosen Tiere. Edited by A. Lang. Zweite Begw. Dritte Auflage. 4 Band, 3 Lief. (Jena: G. Fischer.) 5 marks.

A Text-Book of Quantitative Chemical Analysis. By Dr. A. C. Cumming and Dr. S. A. Kay. Pp. xi + 382. (London: Gurney and Jackson.) 7*s*. 6*d*. net.

Elementares Praktikum der Entwicklungsgeschichte der Wirbeltiere mit Einführung in die Entwicklungsmechanik. By Dr. O. Levy. Pp. viii + 183. (Berlin: Gebrüder Borntraeger.) 5.60 marks.

Conseil Permanent International pour L'Exploration de la Mer. Investigations on the Plaice. General Report. By Dr. F. Heincke. I., The Plaice Fishery and Protective Regulations. First part. Pp. 153 + xxxv + iv plates. Rapports et Procés-Verbaux des Réunions. Vol. xv. Juillet 1911–Juillet 1912. Pp. viii + 167. (Copenhague: A. F. Host et Fils.)

Technological Museum, Sydney. Technical Education Series. No. 18, Cabinet Timbers of Australia. By B. F. Baker. Pp. 186 + lxviii plates. (Sydney.)

Les Lois Empiriques du Système Solaire et les Harmoniques Tourbillonnaires. By F. Butavand. Pp. 43. (Paris: Gauthier-Villars.) 2 francs.

Les Progrès de la Chimie en 1912. Pp. xiv+411. (Paris: A. Hermann et Fils.) 7.50 francs.

Traité de Chimie Minérale. By H. Erdmann. Translated by Prof. A. Corvisy. Tome ii., Etude des Métaux. Pp. 331. (Paris: A. Hermann et Fils.) 10 francs.

Traité de Physique. By Prof. O. D. Chwolson. Translated by E. Davaux. Enlarged edition. By E. and F. Cosserat. Tome iv. Deux Fasc. Pp. 431 to 1162. (Paris: A. Hermann et Fils.) 22 francs.

L'Etude Physico-Chimique des Sels Chromiques. By A. Sénéchal. Pp. 28. (Paris: A. Hermann et Fils.) 2 francs.

L'Additivité des Propriétés Diamagnétiques et son Utilisation dans la Recherche des Constitutions. By M. P. Pascal. Pp. 26. (Paris: A. Hermann et Fils.) 1 franc.

Smithsonian Institution. U.S. National Museum. Report on the Progress and Condition of the U.S. National Museum for the Year ending June 30, 1912. Pp. 165. (Washington: Government Printing Office.)

Leeds Astronomical Society. No. 20, Journal and Transactions for the Year 1912. Pp. 91. (Leeds: R. Jackson and Son.) 2*s.*

Maryland Geological Survey. Middle and Upper Devonian. Text, pp. 720+vi plates. Lower Devonian. Text, pp. 560+vi plates. Devonian. Plates xvii–lxxiii. (Baltimore: Johns Hopkins Press.)

The British Rust Fungi (Uredinales): their Biology and Classification. By W. B. Grove. Pp. xii+412. (Cambridge University Press.) 14*s.* net.

Rubber and Rubber Planting. By Dr. R. H. Lock. Pp. xiii+245+x plates. (Cambridge University Press.) 5*s.* net.

Plane Geometry. By Prof. W. B. Ford and C. Ammerman. Edited by E. R. Hedrick. Pp. ix+213+xxxi. (London: Macmillan and Co., Ltd.) 3*s.* 6*d.* net.

Recent Physical Research. By D. Owen. Pp. 156. (London: *The Electrician* Printing and Publishing Co., Ltd.) 3*s.* 6*d.* net.

The Principles of the Application of Power to Road Transport. By H. E. Wimperis. Pp. xiv+130. (London: Constable and Co., Ltd.) 4*s.* 6*d.* net.

Selektionsprinzip und Probleme der Artbildung: ein Handbuch des Darwinismus. By Dr. L. Plate. Vierte Auflage. Pp. xv+650. (Leipzig and Berlin: W. Engelmann.) 16 marks.

The Hope Reports. Edited by Prof. E. B. Poulton. Vol. viii. Appendix 1890–1910, including Five Subfamilies of the Blattidæ. By R. Shelford. Vol. viii., 1910–13, with a Separate Appendix. Vol. ix. 1911–13, The Natural History and Description of African Insects, especially the Acraeine Butterflies. (Oxford.)

The Cambridge Diary for the Academical Year 1913–14. (Cambridge University Press.) 1*s.* net.

The Cambridge Pocket Diary, 1913–14. (Cambridge University Press.) 1*s.*, 2*s.*, 2*s.* 6*d.* net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 31.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—The Difference between a Drain and a Sewer: R. Kelsey Jones.

MONDAY, NOVEMBER 3.

SOCIETY OF ENGINEERS, at 7.30.—Accretion at Estuary Harbours on the South Coast of England: G. O Case.

ARISTOTELIAN SOCIETY, at 8.—President's Address: Appearance and Real Existence: Prof. G. Dawes Hicks.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Studies in Oxidation. IV. The Production of Oxygen by Electrolysis. Peroxidation as Determined by Platinum and other Catalysts: Prof H. E. Armstrong.—Analysis of Crude Glycerine by the International Standard Methods 1911. Determination of Organic Residue: R. G. Grimwood.—Observations on the Abel Heat Test: Bertram J. Smart.

TUESDAY, NOVEMBER 4.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Striation of Flint Surfaces: J. R. Moir.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: Prof. A. W. Porter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Presidential Address: A. G. Lyster.

WEDNESDAY, NOVEMBER 5.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Preparation of Rubber for Analysis: L. Archbutt.—The Examination of Commercial Gelatines in Reference to their Suitability for Paper Making: R. W. Sindall and W. Bacon.—Some Experiments on Chlorine Compounds of Ethane and Ethylene, with Special Reference to their Applications to Analytical Chemistry: L. Gowing-Scopes.—The Detection and Estimation of Benzoic Acid in Milk and Cream: E. Hinks.

ENTOMOLOGICAL SOCIETY, at 8.—New or Little Known Heterocera from Madagascar: Sir Geo. H. Kenrick.

GEOLOGICAL SOCIETY, at 8.—Geological Sections through the Andes of Peru and Bolivia: Dr. J. A. Douglas.

THURSDAY, NOVEMBER 6.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Soil Solution and the Mineral Constituents of the Soil: A. D. Hall, W. E. Brenchley, and L. M. Underwood.—Studies in Heredity. II. Further Experiments in Crossing British Species of Sea Urchins: Prof. E. W. MacBride.—Synthesis by Sunlight in Relationship to the Origin of Life; Synthesis of Formaldehyde from Carbon Dioxide and Water by Inorganic Colloids acting as Transformers of Light Energy.—Prof. B. Moore and T. A. Webster.—The Trypanosomes causing Dourine (Mal de Coit or Beschälseuche): Dr. B. Blacklock and Dr. W. Yorke.—Postural and Non-Postural Activities of the Mid Brain: T. G. Brown.—The Nature of the Coagulent of the Venom of *Echis carinatus*: J. O. W. Barratt.

FRIDAY, NOVEMBER 7.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Experience in the Design and Working on Different Kinds of Fuel for Gas Producers: G. E. Lygo.

GEOLOGISTS' ASSOCIATION, at 8.—Annual Conversazione.

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" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2297, VOL. 92] THURSDAY, NOVEMBER 6, 1913 [PRICE SIXPENCE

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THURSDAY, NOVEMBER 6, 1913.

GERMAN SCHOOL CHEMISTRY.

Methodik des chemischen Unterrichts. By Dr. Karl Scheid. Pp. xv+448. (Leipzig: Quelle und Meyer, 1913.) Price 20 marks.

EDUCATIONAL restlessness, so characteristic of the times in England, prevails to a scarcely less degree in the country to which we are so often directed to turn for pedagogic inspiration; and the agitation about methods of teaching science is not the least remarkable example of the contemporary stir in the educational world of Germany.

The present volume is the fourth of a series constituting a handbook of scientific and mathematical instruction issued under the editorship of Dr. J. Norrenburg, and is written by a professor of the Realgymnasium mit Oberrealschule at Freiburg in Breisgau. "Knapp und einfach in der Form," it is declared to be by the editor; "Knapp" it may be by Teutonic standards, but it extends to about 450 large pages, and it "grinds exceeding small," as books on Methodik are apt to do in every language. However, the work is of much interest, and to a large degree readable. It refers to German boys' schools, and the terminology of the German system, with its slight and subtle variations, presents some difficulty to the English reader.

The first or general part of the book gives an account of the history of chemistry teaching in German schools, a description of its present condition, and of the various recommendations and criticisms that have been made by scientific, medical, or industrial authorities. The general educational principles involved in science teaching are discussed at considerable length with a great deal of division and sub-division. The second or special part of the book gives the outline of a suggested course of school chemistry.

The chief impression produced by reading this account of German school science is the comfortable one that we in England are well in advance of Germany in our attempts to make science worthy of its place in the school curriculum. It is somewhat remarkable that a German writer should have paid such little attention to what has been going on in other countries. There is a eulogistic reference to Faraday's "Chemistry of a Candle," but no allusion to the very great work that has been done in England during the last twenty-five years towards improving school science.

The difficulties recounted by Dr. Scheid, the unsatisfactoriness of the traditional methods, and the obstacles to reform, are very much the same as we have known here. There has been a strong academic prejudice against the intrusion of science into the school curriculum; the science that has been taught has been diluted university science administered dogmatically; sciences have been artificially severed; they have been detached from living nature and from human interests; they have resulted in a thing of shreds and patches that has been of no account for any terrestrial or celestial purpose. Against all this a rebellion has been fermenting; the demonstration is condemned; the pupils are to work in laboratories; they are to be put into the position of discovering rather than of being told; things, in fact, are moving as they have moved here, but they have not moved so fast.

There are many wise things said in the book, which, if they are not new, are the things that need to be said again and again. Dr. Scheid insists, for example, that the school teacher must remember that he has not got a collection of prospective chemists before him; that the method of teaching is more important than the range of matter; that every occasion must be taken to connect school teaching with the realities of life and industry; that the artificial tendency, not imposed by nature, between natural history and the exact sciences must disappear, if the realistic (*i.e.* modern) schools are to be true educational institutions in a thorough cultural sense. Only then will the Ober-realschulen and Realgymnasien be in a position to give a scientific education equivalent to the humanistic one. The distribution of different branches of science to different teachers, the severance of physics from chemistry, are deprecated. Chemistry dissociated from physics, says the author, is resolved into a mosaic of details. Boyle, Dalton, and Davy were chemists and physicists in one person.

The course of chemistry outlined by Dr. Scheid is not quite like those which have supplanted the old academic courses that prevailed in this country. He begins with limestone, and makes it the object of some fundamental observations, partly quantitative, passing then to air and combustion. Sulphur and sulphuric acid lead to hydrogen, and then comes water. Flame, salt, and hydrochloric acid, quantitative experiments on the laws of combination, carbon and carbon dioxide, carbonates, nitrogen compounds, phosphorus, silicon, and the heavy metals—these complete the topics of the lower course. The higher is more like the traditional systematic course. Proposals for the treatment of organic chemistry begin with alcohol, and include a restricted list of the substances and topics related more especially to everyday life.

L

Whilst the course suggested is in many respects interesting, and no doubt a great improvement on much that has prevailed, it does not seem to be better than many that are now being followed in this country.

It is well known that the prominent position taken by Germany in chemical science is in no degree due to the quantity or quality of the chemistry in its schools. We still hear, indeed, from time to time, of the pronouncement made a score of years ago by a group of eminent German chemists to the effect that a classical education was to be preferred above all else as a preparation for the serious study of science. This pronouncement is akin to many that are heard in the world of education, and is of the nature of those half-truths which are so particularly mischievous. Just as in this country, so long as modern studies were disdained and were the resort of the less intellectually gifted, and so long as modern studies were being taught on a vicious model, ancient studies might well seem to be the best preparation for every kind of higher training.

It will be interesting to see the face of German education when Dr. Scheid and his coadjutors have achieved their reform of its school science. Meanwhile it matters much less in Germany than here whether school science is good or bad, for in Germany there is plenty of education, and of good education, of some kind; there is a sincere belief in it; there is a sincere belief in science; and there are plenty of men sufficiently well trained to keep the country eminent in science and pre-eminent in the application of scientific knowledge to the welfare of the State.

ARTHUR SMITHELLS.

ZOOLOGICAL BIBLIOGRAPHIES AND CATALOGUES.

(1) *Catalogue of the Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History)*. Vol. iv., P—SN. Pp. 1495–1956. (London: British Museum (Natural History); Longmans, Green and Co., 1913.)

(2) *A Bibliography of the Tunicata*, 1469–1910. By John Hopkinson. Pp. xii + 288. (London: The Ray Society; Dulau and Co., Ltd., 1913.) Price 15*s*. net.

(3) *Catalogue of the Noctuidæ in the Collection of the British Museum*. By Sir G. F. Hampson. Plates cxcii–ccxxi. (London: British Museum (Natural History); Longmans, Green and Co., 1913.)

(4) *Catalogue of the Ungulate Mammals in the British Museum (Natural History)*. Vol. 1, Artiodactyla. Family Bovidæ, Subfamilies Bovinæ to Ovibovinæ. By R. Lydekker, F.R.S. Pp. xvii + 249. (London: British Museum (Natural History); Longmans, Green and Co., 1913.)

(1) THE British Museum of Natural History continues to issue at frequent intervals a series of extremely useful catalogues, guides to the collections, or other valuable volumes. Not the least welcome of these to workers in the museum, although probably not of general interest to the public, is the "Catalogue of the Books, Manuscripts, Maps, and Drawings." This, under the superintendence of Mr. B. B. Woodward, the librarian, is still in course of completion, and vol. iv. now lies before us. Starting at P, it brings the entries under authors' names down to SN. We learn from the director's preface that the first sheet was passed for press in October, 1910, and the issue of this volume marks a distinct advance in cataloguing a library, the value and richness of which is probably known to very few of the public.

(2) A catalogue of a very different nature is Mr. John Hopkinson's "Bibliography of the Tunicata," from 1469–1910, compiled for the Ray Society. This was commenced for the private use of its author in connection with the publication by the Ray Society of the late Messrs. Alder and Hancock's "British Tunicata." During the course of its completion it was found to contain so many references not in any previous bibliography that it appeared to Mr. Hopkinson that if printed it might be useful to others—a surmise which we expect will prove correct, as the bibliography, which must have involved immense labour, has been very carefully prepared.

(3) A second volume issued by the British Museum contains plates 192–221 of Sir George Hampson's "Catalogue of the Noctuidæ." In this a large number of species are illustrated, the work having been carefully executed by Messrs. West, Newman and Co. The colours have been very well reproduced; each species is named, and a reference given to its habitat and the page on which it is described.

(4) The first volume of Mr. R. Lydekker's "Catalogue of the Ungulate Mammals" deals with the cattle, sheep, goats, chamois, takin, and musk-oxen. Owing to the large size of most of the species and the relatively small number of specimens available, the work is written on lines different from those governing other catalogues. Real systematic detail and thorough conciseness of description cannot be attained until a much larger series of specimens can be accumulated. Instead, although the principle of priority in scientific nomenclature has been adhered to, an

attempt has been made to render the descriptions as little obtuse as possible, so that they may be of interest to sportsmen as well as to scientific naturalists, to the former of whom the Ungulates are of special interest.

Recent minute study and careful comparison of specimens has led to such multiplication of species that new arrangements of them are unavoidable. In most modern works an attempt is made to group the known forms by instituting new and narrower genera which are often identical with old-time species. Mr. Lydekker attempts to attain the same end by classing nearly-related forms as races of a single species. We are not sure that we approve of this method, which involves a greater use of trinomials, where binomials would often suffice, and is, we think, a hopeless struggle against modern tendencies. In the case of the musk-oxen this practice gains nothing; nor does it seem a great advantage to grade all the sheep inhabiting the North American continent as subspecies of *Ovis canadensis*. In other respects we have nothing but praise for a work which will certainly be valued by those for whom it is intended.

THE SCIENCE OF FORESTRY.

(1) *The Theory and Practice of Working Plans* (*Forest Organisation*). By Prof. A. B. Recknagel. Pp. xii + 235 + 6 plates. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 8*s*. 6*d*. net.

(2) *The Important Timber Trees of the United States: A Manual of Practical Forestry*. By S. B. Elliott. Pp. xix + 382 + plates. (London: Constable and Co., Ltd., 1913.) Price 10*s*. 6*d*. net.

(3) *A Handbook of Forestry*. By W. F. A. Hudson. Pp. ix + 82. (Watford: The Cooper Laboratory, n.d.) Price 2*s*. 6*d*. net.

THE output of forestry literature in America is becoming remarkable. In addition to several admirable periodical publications like the *Forest Quarterly* and the Proceedings of the Society of American Foresters, as well as the numerous bulletins, circulars, and miscellaneous works issued by the Forest Service at Washington, there are constantly appearing now useful text-books on the different branches of the science of forestry. These are especially valuable to us, as, with the exception of the standard works of Nisbet and Schlich, which are necessarily limited and stereotyped in scope, scarcely any serious books on forestry have appeared of late years in England. In arboriculture, which is the study of individual trees, on the contrary, English writers still keep up the tradition of Loudon and are in the first rank.

(1) Forest organisation is the subject of an excellent book by Prof. Recknagel, of Cornell University. The works in English on this important branch of forestry hitherto available have been practically two only, Schlich's "Manual," vol. iii., somewhat limited in scope, and D'Arcy's "Working Plans," confessedly confined to Indian practice. We have had no treatise which gave a general discussion of the subject. The merit of Prof. Recknagel's work is the clear and concise way in which he treats of the different methods of estimating the yield of the forest, and the ample details which he gives concerning the modes of management in Germany, Austria, France, and the United States. The author agrees with Schlich in considering that Judeich's method is the most rational of the seventeen methods described for determining the yield, *i.e.*, of calculating the actual amount of timber that should be cut annually in a forest, which is worked so as to give a constant annual return. This method, with obvious simplifications, can be adapted to ordinary estates in England, on which there is a considerable area of woods of different ages. On p. 53, line 9, there is an obvious error: 49,000 should read 24,500.

(2) It is significant of the depletion of the timber supplies of the United States that numerous books are now being published there which deal with the formation of new woods by planting methods. The latest of these, by Mr. Elliott, is designed for the use of private landowners in America. The first part (pp. 1–129) deals with the ordinary details of sylviculture, and contains nothing novel, though the account of nursery work, as it is carried on in Pennsylvania, with illustrations of the State Forest Nursery, is of considerable interest.

The second part of the book (pp. 130–357) is a description of the important timber trees which are suitable for planting for profit in North America. There is scarcely any information in this which will be of much service to English foresters, as the author's experience is mostly drawn from the eastern part of the United States, while for us it is the Pacific Coast trees that are of value. His knowledge of the latter is limited, as evidenced by the perfunctory way in which the Douglas fir is treated, and the omission of the Sitka spruce. The statement that "one who purchases Western hemlock believing it to be Oregon pine is not much wronged" is quite erroneous. The latter tree (*Pseudotsuga Douglasii*) is, of course, much superior to the hemlock, both in rate of growth and in the quality of the timber produced. The account of the cultivation in America of Scots pine, European larch, and Norway spruce is of considerable interest. All three grow well for a time, but never make good trees in the eastern parts of the United States.

(3) The "Handbook of Forestry," which has been issued by the Cooper Laboratory at Watford, is inconvenient to handle, being a thin folio of 82 pages, with 25 illustrations of very unequal merit. While generally sound in regard to practice, it contains nothing that has not been said before in several small, handy text-books, and is startling in its omissions. While the London plane is included as a forest tree, the Corsican pine, which is the most valuable of its genus for many soils and situations, is omitted. In the chapter entitled "conditions affecting growth" nothing is said about the important questions of altitude, exposure to wind, situation near the sea or inland, and latitude, all important factors influencing the choice of species and the formation of new plantations. The "Black Poplar" (*Populus nigra*) is correctly drawn; but in the description it is confused with the "Black Italian Poplar" (*Populus serotina*), the fast-growing hybrid tree, which should always be planted in preference to the former, when timber is required.

Such statements as (p. 64) that the lime is not indigenous, and names like *Tilia magnifolia*, show that the author is not well acquainted with forest botany. The two native birches are distinguished by drawings, but nothing is said of their very different soil-requirements.

OUR BOOKSHELF.

Practical Stone Quarrying: a Manual for Managers, Inspectors, and Owners of Quarries, and for Students. By A. Greenwell and Dr. J. Vincent Elsden. Pp. xx + 564. (London: Crosby Lockwood and Son. 1913.) Price 12*s*. 6*d*. net.

WHEN our hard-headed forbears were roving Piltdown, the art of the quarryman could scarcely have been in its infancy; yet we have far to travel in the mazes of the past if we must find its beginnings, and the work of some of the early masters of the craft still remains to excite our wonder. From the nature of the material ancient methods were very like our own, and probably differed mainly in speed.

Old though the art may be we are still in doubt as to what a quarry is; most likely the ancient quarryman was not troubled with this question, but now, what with Acts of Parliament, judicial embellishments, and the sanction of custom, it has become impossible to define "quarry." The authors of this volume have made a brave effort to clear up the confusion; it is very interesting, but scarcely successful. They have had almost as much difficulty with "stone"; however, by including some "mines" among the quarries and omitting to take account of some materials which would come under their own definition of stone, they have succeeded in producing an eminently satisfactory book on the subject, one for which there was a real need.

After an adequate discussion of the occurrence of stone, the distribution of quarries in the United Kingdom, and divisional planes in rocks, there follows some excellent advice on the location of quarries and their proper development, a subject of the greatest importance.

A large amount of space is devoted to methods of extraction, tools, blasting, cableways, and haulage systems. The table, p. 300, giving the amounts of different explosives used in the United Kingdom, would have been more valuable if the explosives had been classified according to the kind of rock and the uses of the stone.

A short chapter treats of the preparation of stone for the market, another with the dangers of quarrying, and the book concludes with some remarks on quarry legislation which may be commended to the notice of those in authority. The volume is very well illustrated, and there is a fair index.

The Microtomist's Vade-Mecum. A Handbook of the Methods of Microscopic Anatomy. By A. B. Lee. Seventh edition. Pp. x + 526. (London: J. and A. Churchill, 1913.) Price 15*s*. net.

WE gladly welcome the new edition of this work which has become indispensable in all laboratories of biology. The general plan and the size of the book remain unaltered, but the author has managed by judicious "pruning," and some exclusion of out-of-date matter, to introduce much new matter, more than seven hundred additonal entries appearing in the index.

Goldmann's *intra-vitam* staining methods, and improvements in the silver fibril stains of Bielschowsky and Ramón y Cajal are detailed. Gibson's new mounting media, which dispense with the use of clearing agents, and confer on unstained or feebly stained objects just the required degree of visibility, are described. The sections relating to the blood and blood parasites have been rewritten. Not the least useful part of the contents are the full references given to the literature of the subject. Those who have worked with former editions will find that the present one maintains in all respects the high standard of its predecessors. R. T. H.

Astronomy Simplified. By Rev. Alex. C. Henderson. (London: James Clarke and Co., 1913.)

THE object of this book is, as the author states, "to extend a knowledge of the sublimest of the sciences," and he intentionally reminds the reader many times throughout the pages that while man is striving to find out the laws which govern the behaviour of matter in space, there is a greater

Power who not only created the laws, but formed matter and space.

The book consists of three chapters, covering seventy-five pages, followed by a series of subsidiary chapters, which are termed notes, which extend another seventy-one pages. The three chapters deal with general information about the sun, moon, and stars, diurnal motions of the heavenly bodies and comets. The treatment is quite elementary, clear, and brief, and the information accurate. The notes, which are twenty-six in number, treat of a miscellaneous set of subjects relating to astronomy, and may be considered in some cases as brief essays. The headings of some of these notes are as follows:—Auroræ, magnetic storms, sun-spots, and prominences; seven methods of obtaining accurate time; eclipses; proofs of the earth's rotundity, &c.

The book is neatly produced, contains numerous illustrations, and will no doubt serve a useful purpose in drawing youthful minds to the subject of astronomy.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Philosophy of Vitalism.

I think that I voice the feelings of all London zoologists when I say how grateful we all are both to the Zoological Board of the University of London and to the governing body of King's College for the opportunity which they have afforded us of hearing the new philosophy of vitalism so brilliantly expounded by Prof. Hans Driesch.

Perhaps you would spare me a little space if I try to set forth some reasons why Prof. Driesch's conceptions do not appear to me to be of much service in assisting the progress of zoology.

At the outset, one or two preliminary remarks may be made. The question whether for any consistent system of philosophy, or attempt to explain the universe, an idealistic attitude must be adopted, and the question whether at the present juncture idealistic conceptions ought to be imported into zoological science are two entirely different things.

The task of zoologists is not to explain the universe; it is the much humbler one of endeavouring to compare together zoological phenomena and to ascertain the rules governing them. All "explanation" is merely comparison; we endeavour so far as we can to express the more complex phenomena in terms of the simpler, and so to find uniformity and order beneath an apparent welter of unconnected details.

Now Prof. Driesch offers us an "entelechy," *i.e.* a non-material, non-mechanical "*arranging*" power, a rudimentary "psychoid" which knows its purpose and uses the materials at its disposal in order to effect that purpose. Does the conception of entelechy help us to collate zoological facts or not?

It was invented to account for the remarkable fact that when the first two blastomeres of the egg of a sea-urchin are separated from one another each will give rise to a perfect larva of diminished size. Driesch argued that since in normal circumstances one of these blastomeres would have given rise to half a larva, therefore when it is separated from its fellow some innate power must be at hand to rearrange the materials of the blastomere so as to give rise to a whole larva. But if the conception of an entelechy will cut the Gordian knot of this difficulty, there are a great many cases where the facts seem to be totally inconsistent with the existence of an entelechy.

If the tail of a lizard be broken off a little bud is formed at the injured surface, from which in due time a new tail is developed. But if this bud be slightly indented by a prick from a knife *two* tails and not one are developed from the bud.

What is the entelechy doing in this case? Is its purpose altered, and has it decided to use the materials to make two tails? Are we not justified in saying that if an entelechy was invented to explain why one blastomere of a sea-urchin's egg forms a whole larva, it must be rejected because it utterly fails to explain why the injured bud on a lizard's tail makes two tails?

Again, if, when the egg of a frog has divided into two blastomeres it be tightly clipped between two glass slides in order to prevent its rotating, and if the whole preparation be inverted, then there will often result a ghastly two-headed tadpole. Why does the entelechy allow its purpose to be upset by so small a thing as the inversion of the egg? Is this not a much less violent change than cutting the egg in two? Instances of this kind might be multiplied indefinitely, and they show that at the best the conception of an entelechy is of quite limited application. There is another conception which is far more helpful in binding together phenomena, and that is the idea of "organ-forming substance." In the egg of Cynthia, an Ascidean, the development of which has been worked out by Conklin, these organ-forming substances can be seen in the living egg. This case was not alluded to by Prof. Driesch, as it is one which is almost impossible to reconcile with his theory. In the egg of Cynthia there is a yellow substance in the outer layer of the protoplasm. This collects round the entering spermatozoon when the egg is fertilised, and eventually forms a crescent in one quadrant of the egg. As development proceeds it is relegated to certain cells in the segmenting egg, and is eventually used up in forming the longitudinal muscles of the tail of the Ascidean tadpole. Now it is possible to kill the cells containing this substance on one or both sides of the segmenting egg. If the cells on one side be killed then there results a larva devoid of muscles on one side of its tail.

Now if we assume that normal development depends on the juxtaposition of certain organ-forming substances in certain spatial relations to one another, then when the two-cell stage of the egg of a frog is inverted these substances can partially or totally rearrange themselves, not under the influence of an entelechy, but under the influence of gravity. So also in the regenerating lizard's tail, the spatial relations of the organ-forming materials with respect to one another are altered by the indentation produced by the knife, and so two tails and not one develop.

Whence do these organ-forming substances come? The development of the egg of Cynthia teaches us that they arise from the nucleus of the ripe egg, and that they are definitely arranged (in some cases at least) under the influence of the spermatozoon. The ectoderm-forming substance of the egg of Cynthia is contained in the nuclear sap of the unripe egg and is emitted when the nuclear membrane breaks down. "But," Driesch will reply, "I have shown that the nuclei of a segmenting egg can be displaced from their normal positions without altering the result." Granted. When once fertilisation has been effected and the arrangement of materials in the cytoplasm fixed, the nuclei which result from the division of the zygote nucleus enter on a period of inactivity so far as influence on the cytoplasm is concerned. But this inactivity does not last for ever, for though the Cynthia tadpole is incapable of regenerating anything, that same tadpole metamorphosed into an adult Ascidian will regenerate any part that is cut off—even its head. In the same way Roux showed that when one blastomere of a frog's egg is killed the surviving blastomere will give rise to half a tadpole; but that half-tadpole, if it lives, will *post-generate* the missing half, and this belated regeneration is accompanied by a migration of nuclei into the injured half.

It may be objected that it is difficult to imagine what kind of chemical composition an "organ-forming substance" possesses. This is true; it may be difficult to compare it with chemical substances found in dead matter, but our knowledge of the possible complications of organic substance in living matter is as yet small. This at least may be said, the active agent in development and regeneration can be displaced from its original position, and can be divided into two, and such attributes are much more easily connected in our minds with a substance than with a non-material entity, which, Prof. Driesch assures us, is not in space.

E. W. MACBRIDE.

Imperial College of Science, October 28.

The Piltdown Skull and Brain Cast.

IN suggesting that a reconstruction of the Piltdown skull, made by the use of casts of the actual fragments, is not trustworthy (NATURE, October 30, p. 267), Prof. Elliot Smith does Dr. Smith Woodward and Mr. F. O. Barlow less than justice. The casts now in circulation are most accurate representations of the originals, and reflect the greatest credit on the modeller, Mr. Barlow. Anatomists have had no difficulty in gaining the freest access to the actual specimens; even those who, like myself, regard the original reconstruction of the skull and brain cast as fundamentally erroneous, have had every privilege granted to them on repeated visits to see the Piltdown fragments in Dr. Smith Woodward's keeping. A reconstruction made from casts is then just as trustworthy as one made from the original fragments.

You have already (NATURE, October 16, p. 197) permitted me, by the use of a diagram, to demonstrate the errors in the original reconstruction; I also availed myself of that opportunity to show diagrammatically the only reconstruction which gives an approximate symmetry to the right and left sides of the head, and, at the same time, places the parts in their proper anatomical positions. It is clear, from his letter (NATURE, October 30, p. 267) that Prof. Elliot Smith knows of another method, one which fulfils the same conditions, but gives a much smaller brain-capacity. All that is necessary to convince me that he is right and I am wrong is a drawing of that reconstruction: one comparable with the drawings in my previous letter. I have articulated the fragments in the manner suggested in his letter, and find that the degree of asymmetry in his suggested reconstruction is as great as in the original. It is possible that I have misinterpreted some of the indications given in his letter. Any error of this kind would be cleared up by a drawing.

ARTHUR KEITH.

Royal College of Surgeons,
Lincoln's Inn Fields, W.C.

Pianoforte Touch.

PRESSURE of other work has prevented me from replying earlier to Prof. Pickering's letter in NATURE for July 31. It is, of course, difficult to express any definite opinion about an experiment without fuller knowledge of the circumstances than can be acquired from a mere written description; at the same time it appears to me very easy to suggest explanations for the failure of the experiment. To strike the same note a hundred times in succession is certainly a very severe test to impose on a person's powers of discrimination. In this connection it would be interesting to perform, for the sake of comparison, one hundred tests of a totally different character, say the well-known tests of blindfolding a person and making him taste tea and coffee, according to a prearranged succession. It would be giving the hearer a fairer chance if the experiment were performed by playing over a short sequence of notes, say a simple melody a number of times in succession. I have always performed the test in this manner, and it has generally been successful.

Then, again, there is evidently a certain knack about producing these touch effects, and though one may try to strike a note sometimes in a pressing or caressing manner, and sometimes sharply, it is quite easy to fail to produce the desired effects, especially if the note is struck by the fingers. The best results I have been able to get in this way have usually been produced by holding the wrists high above the keyboard for a brilliant tone and right below the keyboard (so as almost to pull the keys down) for a soft tone. In producing the same effects with a pneumatic player, variation of the load on the regulating bellows by means of my sliding weight or some equivalent method produces sufficient differences, but the action of the feet in pedalling has so much effect on the touch that even here it is easy to fail, especially in experimenting where the performer consciously attempts to produce a particular effect and thinks of what he is doing. In the course of playing a composition the touch control is easier, as the necessary movements of the hands and feet are performed unconsciously, the performer only being conscious of the effect produced and not thinking of why or how he moves his levers and pedals to produce that effect.

Another point which has been overlooked in this discussion is that different makes of piano respond in very different degrees to small differences of touch. I recently tested a number of different pianos, and found that the make which I always use was by far the most sensitive, while one of the least sensitive was similar to the piano used by our local musical society, thus accounting for the comparative harshness of some of the professional performances compared with my pneumatic effects.

It is, of course, necessary to distinguish carefully between variations in quality of individual notes and variations in the quality of *chords*. The possibility of producing the latter variations in the pneumatic player is proved beyond doubt, and, to my mind, it is very largely the failure of either the instrument or the performer to produce a pleasing balance between the various components of a chord that renders the playing so mechanical and uninteresting. The usual effect is to produce with soft playing a heavy bass drowning a dull treble, and with loud playing a shrill treble drowning a weak bass. This effect is probably due to a large extent to the action of the regulating bellows, which in the ordinary players are controlled by springs. In playing a chord a number of different striking hammers of unequal mass have to be set in motion by means of the air pressure, or rather tension, acting on the "playing pneumatics" or small bellows which operate the fingers, and the duration of the impulse necessary to produce the maximum effect is greater for the bass than the treble hammers. Now the regulating bellows are in a continual state of vibration, producing rapid fluctuations of tension every time a note is played. If these fluctuations synchronise with the impulses required to produce the maximum effect in a particular part of the scale, it is evident that the corresponding part of the chord will predominate. Now, in playing softly the regulating bellows are only slightly compressed, and they open and shut slowly; in playing loudly they are much more highly compressed, and they collapse and open sharply. Thus the unpleasing want of balance in the quality of chords is easily accounted for. This difficulty I get over by varying the load on the regulating bellows, and also the inertia by means of a sliding weight, as well as by controlling its vibrations by hand. I have seen a patent in which it is sought to control the regulating bellows by enclosing it in an air chamber in which the tension can be varied by means of valves, and attempts have also been made to vary the tension in a spring controlling the bellows; but this can only be done by compressing the spring by a corresponding amount, and the time required to produce this compression appears to be too long to render the method efficacious.

The usual method of concealing this want of balance is to operate the two halves of the keyboard with separate controls. This system produces effects which are pleasing at first, but are very artificial and limited in character, and a person who is accustomed to this method of "faking" his chords is scarcely likely ever to learn how to balance their different parts with due regard to the effects required. Possibly this explanation may clear up some of the obscure points in my descriptions referred to by Prof. Morton. At the same time, I have heard professional pianists of considerable reputation whose range of control did not extend beyond that obtainable by damping down the halves of the keyboard or accenting notes by means of punch-holes.

Prof. Pickering's references to the sustaining pedal or lever are calculated to suggest the inference that Prof. Pickering may not have had much experience in manipulating his piano-player. If he finds it necessary to listen for each note before he knows when to operate his sustaining lever it would appear that he has not yet learnt *to play each note at the exact instant that he wishes it played,* and in this case it is not easy to see how it would be possible to play accompaniments in which it is necessary to listen to and keep in time with the soloist. Personally, I have always considered that the sustaining lever played a far more important part in pneumatic playing than in hand playing, one reason being that the necessary movements can be regulated with much greater rapidity and precision by hand than by foot. The right hand operating the speed regulator fixes the exact instant at which each note is going to be played, the left hand operates the sustaining levers and other controls at the correct predetermined instant. Probably, as Prof. Pickering says, an experienced pianist can also work hand and foot together, and I have known one musician who could operate the sustaining pedal of the piano three times in succession in holding down a single chord. This would be quite easy with a piano-player, and I certainly often use the lever twice if not three times in playing a chord. But it must be much more difficult to do the same in playing with fingers, and with the majority of amateurs the main use of the loud pedal appears to be to compensate for the loss of resonance caused by boxing up the piano and covering it with rugs, vases, and photograph frames.

The slight sound of suction through the air-holes is, of course, an inevitable defect, but one soon ceases to notice it. As regards "thud," well, fingers as well as pneumatics sometimes produce this.

G. H. Bryan.

The Light Energy Required to Produce the Photographic Latent Image.

The amount of light energy required to produce a latent image on a modern high-speed photographic plate is known to be extremely small. The energy per silver grain may be roughly calculated without difficulty, and the calculation leads to some interesting conclusions regarding the nature of the latent image.

Consider an exposure sufficient to produce a deposit of unit density, that is, one which will transmit but one-tenth of the incident light. A negative has unit density when the silver deposit is 10 milligrams per square decimetre, or 0·1 mg. per sq. cm. (Sheppard and Mees, "Investigations of the Theory of the Photographic Process," p. 41). This amount of silver represents roughly 10^{12} molecules, or 10^7 grains 3 μ in diameter. Now the amount of light energy required to produce an exposure giving unit density is of the order of 10^7 watt-sec (erg) per sq. cm., and therefore 10^{-11} erg per grain, or 10^{-26} erg per molecule. The probable uncertainty in these values is not greater than a factor of 10.

The effect of the light on the plate is to permit the chemical reduction of silver halide to metallic silver with an additional expenditure of energy less than that required to reduce the unexposed silver bromide. Development we know to proceed by whole-grain units, hence we reason that one molecule in a grain (10^{12} molecules) is so affected by exposure that the whole grain is developable.

The simplest assumption to be made is that one electron per grain is detached from one molecule; such a liberation would require (Davis, *Phys. Rev.*, xx., p. 145, and others) 5×10^{-12} erg, or less (*Astroph. Journ.*, xxi., p. 404), a quantity consistent with that calculated above from the known exposure and mass of silver. Hence the hypothesis is reasonable that the latent image consists of halide salt in each grain of which one electron has been liberated by exposure to light.

P. G. Nutting.

Research Laboratory, Eastman Kodak Co., Rochester.

An Aural Illusion.

Mr. Alliston refers in Nature of September 18 (p. 61) to a certain aural illusion, and wonders if anyone has thought of it before.

Two or three years ago, in a letter to *Knowledge*, I commented on the fact that if a flash of lightning 2 or 3 miles long happened to occur "head on" to an observer, the result of the flash travelling so far quicker than the sound would be that he would hear first the thunder caused by the part of the flash nearest to him, which arose last, and then in succession the earlier sounds, until finally he would hear the opening crash, like a phonographic record reversed. Sometimes I have noticed that a thunder peal ends up with a sudden and more violent crash, and I wonder if this is owing to the explosion which begins a peal of thunder being louder and more abrupt than the after noise

T. B. Blathwayt.

Cape Town, October 10.

NATURAL HISTORY AND TRAVEL.[1]

THE latest addition to Messrs. Witherby's well got-up series of volumes on the life-histories of British birds, four of which, dealing with the golden eagle, the osprey, the spoonbill, the stork, and some herons, have already been issued, is quite equal to its predecessors as a contribution to ornithology. The four species of terns (1) are its subject-matter; and the author, Mr Bickerton, is to be congratulated for the excellence of his photographs showing the eggs, the young and adult birds, and the nesting-sites, as well as for the time and labour devoted to securing them, and to compiling the voluminous notes embodied in the text. To the ordinary reader the text is naturally somewhat tedious on account of its prolixity and repetitions, unavoidably due to the similarity in mode of life of the species described; and the value of the volume would have been increased by the addition of a short chapter summarising the results, and pointing out briefly the differences in habit between the several species. This is the only criticism, however, we have to offer of an admirable and painstaking piece of work; and we trust Mr. Bickerton will be able to find the leisure to observe and record the habits of other groups of British birds in a similar way.

"The Charm of the Hills" (2) is mainly a collection of reprints of articles already published in various periodicals, such as the *Scotsman* and *Country Life*. The book is divided into two parts, chapters i. to xxxi. being a miscellaneous series of disconnected chapters dealing mostly with certain aspects of bird-life in the Scotch highlands, while the second part, entitled, "The Year on the Hills," also devoted mainly to birds, recounts observations upon their habits in the Cairngorm mountains in spring, summer, autumn, and winter. Mr. Seton Gordon is an enthusiastic and trustworthy field-naturalist, and while he writes feelingly and well about his own personal experiences, his book contains a great deal that is interesting and instructive to those for whom wild life in the mountains has a fascination.

"The Flowing Road" (3) is full of facts of interest both to the naturalist and the geographer. It is an account of five expeditions, mostly by canoe, along the rivers and streams of the northern countries of South America. Two of these were undertaken with the object of visiting a native people in the south-eastern corner of Venezuela, reported to be savage and unknown. The others, however, as the author tells us, were instigated "neither by a wish to hunt the beasts of the jungle . . . nor to report on the social or industrial conditions of the land, nor even to add to the sum of knowledge of the 'scientific' world—but solely to satisfy the hunger which incites me every now and again to go and 'see things'—the curiosity which Prof. Shale has called the primal instinct." Despite this modest disclaimer, nevertheless Mr. Whitney's narrative, setting forth the true nature of the areas traversed, and of the inhabitants found there, is a really valuable contribution to many branches of knowledge; because there are certainly few districts in the world lying beyond the beaten tracks of travel less accurately known than those drained by the Amazon and the Orinoco and their tributaries, and probably none, according to the author's experience, which have been so frequently and persistently misrepresented in printed accounts inspired by self-interest or based on the superficial observations of casual tourists.

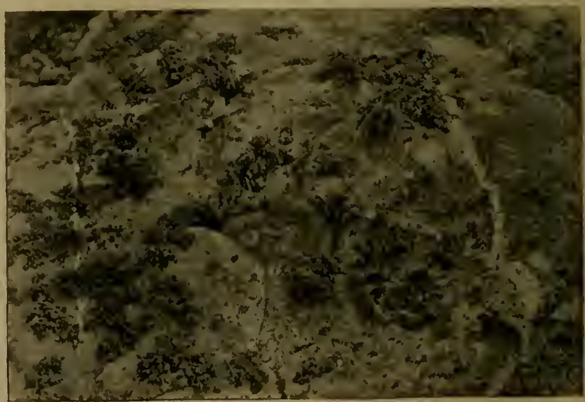


FIG. 1.—The Arctic tern—admirably protected by the surroundings on which it has settled. From "The Home life of the Terns or Sea Swallows," by W. Bickerton.

Those who have heard Mr. Dugmore lecture would expect him to write entertainingly and well about the habits and characteristics of the animals with which he has had personal experience; and those who have read his "Camera Adventures in the African Wilds," will find "Wild Life and the Camera" (4) equally readable and trustworthy, although widely different in its subject-matter, which is confined to North American species.

The greater number of the chapters are given

[1] (1) "The Home-life of the Terns or Sea Swallows." Photographed and Described by W. Bickerton. Pp. 88+xxxii mounted plates. (London: Witherby and Co., 1912.) Price 6*s*. net.
(2) "The Charm of the Hills." By S. Gordon. Pp. xiv+248. (London: Cassell and Co., Ltd., 1912.) Price 10*s*. 6*d*. net.
(3) "The Flowing Road." Adventuring on the Great Rivers of South America. By C. Whitney. Pp. 319. (London: W. Heinemann, 1912.) Price 12*s*. 6*d*. net.
(4) "Wild Life and the Camera." By A. R. Dugmore. Pp. xi+332. (London: W. Heinemann, 1912.) Price 6*s*. net.
(5) "The Feet of the Furtive." By C. G. D. Roberts. Pp. 277. (London: Ward, Lock, and Co., Ltd., 1912.) Price 6*s*.
(6) "Insect Workers." By W. J. Claxton. Pp. xii+62. (London: Cassell and Co., Ltd., 1912.) Price 1*s*. net.
(7) "Letters from Nature's Workshop." By W. J. Claxton. Pp. 192. (London: G. G. Harrap and Co., 1912.) Price 1*s*. 6*d*. net.

up to birds; but there is much to interest anglers in those devoted to salmon- and trout-fishing. Mammals are in a minority; but perhaps the chapter describing caribou migration in Newfoundland is the most valuable in the book from the naturalist's point of view. A few chapters containing instructions and hints on bird and mammal photography, and on camping out, will be most helpful to those who wish to follow in Mr. Dugmore's steps and attempt to do what he has done under similar physical conditions.

"The Feet of the Furtive" (5) contains several well-written stories of a kind much in vogue at the present time, wherein the author weaves interesting facts in natural history into an attractive fabric of fiction. The habits of familiar North American mammals are the theme Mr. Roberts presents so cleverly in this guise; but while giving full play to his imagination and to his powers of linguistic expression, he never oversteps the bounds of probability, and carefully avoids that pitfall authors too frequently dig for themselves and their readers, by attempting to humanise the species whose mode of life they wish to portray. Many of the stories recall others that have already been published by American authors; but there is a distinct air of novelty about the one called "The World of Ghost Lights," which gives a vivid picture of one aspect of life in the ocean depths.

In his little book for children, called "Insect Workers" (6), Mr. Claxton tells once again the story of the burying beetle, trapdoor spider, ants and aphides, wasps, and other common and familiar species of articulated animals the industries of which never fail to appeal to the imagination of children and to arouse their interest in creatures they are mostly taught by their elders to fear and destroy.

The purpose of awakening and fostering a taste for nature-study also underlies "Lessons from Nature's Workshop" (7), by the same author. This book, however, is rather more pretentious in scope than the last, and is written for readers of maturer mind, many of the chapters being devoted to more or less abstract questions in natural history, such as the struggle for existence in plants, assimilative coloration, scenery, and so forth.

R. I. P.

FIG. 2.—The Newfoundland caribou in migration. Going at a quick walk, or swinging trot, or at times a gallop, they usually travel in single file along the well-worn leads or paths that have been used for centuries. In nearly all cases a doe leads the herd. From "Wild Life and the Camera."

PROF. NOGUCHI'S RESEARCHES ON INFECTIVE DISEASES.

THE Royal Society of Medicine mostly limits the record of its work to its own Proceedings and the medical journals; and it does well to observe this wise rule. But from time to time it receives some communication of the highest importance to the general welfare, and on such occasions it is mindful of its immediate duty to the public. It lately held a special meeting, at which Prof. Noguchi, of the Rockefeller Institute, demonstrated the results of his researches into syphilis, general paralysis of the insane, epidemic infantile paralysis, and rabies. None who heard Prof. Noguchi and saw the great crowd of physicians and surgeons listening to him could fail to recognise the profound significance of this occasion.

No man of science works alone or in isolation: and a vast amount of cooperative work is being done in diverse parts of the world on what may be called the "higher types" of germs. Let us note the development of the work. Let us go back half a century, to the earliest methods of Pasteur. We may take 1855 as an approximate date for the beginning of the founding of "the germ-theory." For many years the only method which Pasteur had for the growth of germs in pure culture was the use of fluid media, such as broth; and, under the conditions of bacteriology fifty years ago, the use of these fluid media was full of difficulties. He had to wait until 1872 for the discovery that germs could be grown on solid media, such as gelatine or slices of potato. He had to wait until 1875 for the discovery that germs could be stained with aniline dyes so as to distinguish them, under the microscope, from their surroundings.

Pasteur lived until 1895—that is, ten years after the first use of his protective treatment against rabies, and two years after the first use in practice of diphtheria antitoxin—but he did not live to see more than the beginning of the study of the higher types of germs. At the time when he died, many of the lower types—the bacilli and the micrococci—had been discovered, isolated, grown in pure culture on solid media, and proven, by the inoculation of test animals, to be the very cause of this or that infective disease. But the higher types, such as the *plasmodium* of malaria, were still waiting to be worked out. Then, after Pasteur's death, came Ross's fine work on malaria; and then came two discoveries of no less importance—the discovery (Schaudinn, Hoffmann) of *Spirochaeta pallida* in cases of syphilis, and the discovery (Forde, Dutton) of *Trypanosoma gambiense* in a case of sleeping sickness. These two discoveries brought syphilis and sleeping sickness, at last, within the range of practical bacteriology. Long ago, Moxon had said of syphilis that it was "a fever cooled and slowed by time"; but the cause of that fever was unknown until the *Spirochaeta pallida* was discovered.

But to prove that it does not merely accompany, but actually causes the disease, it had to be grown in pure culture, and inoculated into test animals, producing in them some characteristic sign. Syphilis must be studied as diphtheria, tetanus, typhoid fever, and tubercle had been studied. That is the meaning of all the work done by Ehrlich and his school upon salvarsan—that, in particles of tissue from a rabbit in which the disease has been produced, the *Spirochaeta pallida* is present, under the microscope, before a dose of salvarsan, and is absent after it.

The work has been of immeasurable complexity, and there is much still to be done. There are many species of spirochætes discoverable in this or that condition of bodily life, besides *Spirochaeta pallida*; indeed, Prof. Noguchi demonstrated seven species. But he has cleared the way in this field of bacteriology. He has distinguished those which need some air for their growth from those which cannot grow in air; he has discovered the method of adding a fragment of sterilised animal substance to each tube of pure culture: and these methods are of great value.

But that is not all. For he has detected *Spirochaeta pallida* in the brain, in general paralysis of the insane. He has found it in twelve out of seventy specimens. There is no need to underline the importance of that statement.

Also, Prof. Noguchi has obtained in pure culture the germs of anterior polio-myelitis (epidemic infantile paralysis). Of all the many diseases of childhood in which the art of medicine, apart from its science, is of no great use, few are more unkind than infantile paralysis. It is the Rockefeller Institute that we must thank here. First came Flexner's magnificent work on epidemic cerebrospinal meningitis, and his discovery (1908) of the special antitoxin for that disease; then came the study of epidemic infantile paralysis. To have in one's hands, in a test-tube, infantile paralysis, is a grand experience for a man who has attended a children's Hospital, year in year out, long before the Rockefeller Institute was born or thought of. It is enough to make him believe that the doctors some years hence may be able to stop the disease before it can inflict irremediable injury on the nerve cells of the spinal cord.

Finally, Prof. Noguchi spoke of rabies (hydrophobia). He has been able to obtain, in pure culture, the microscopic bodies which Negri discovered in the brain in that disease. He demonstrated to the Royal Society of Medicine, on the lantern-screen, photographs showing the cycle—not unlike that of the *plasmodium malariae*—through which these bodies pass until, like miniature shrapnell, they break, setting free their constituent granules; and each granule becomes a "Negri body," and starts the cycle again. Happily, the protective treatment against rabies did not have to wait for the discovery of these Negri bodies. Pasteur worked at rabies, as Reed and Lazear worked at yellow fever, knowing that the virus was there, and able to control, fight, and beat it, without seeing it under the microscope.

The Royal Society of Medicine deserves the thanks of the public for inviting Prof. Noguchi to give this demonstration in London. He is indeed, in width and originality of work, equal to his fellow-countryman, Prof. Kitasato. He has helped to make it possible for men of science to extend to other diseases those methods of study which brought about the discovery of diphtheria antitoxin, and the protective treatments against cholera, typhoid fever, and plague.

STEPHEN PAGET.

EDWARD NETTLESHIP, F.R.S.

Mr. E. Nettleship, whose death on October 30 we have to deplore, was well known to the public as a distinguished ophthalmic surgeon, and to men of science as an enthusiastic worker on the subject of heredity. He was one of the six sons of Henry John Nettleship, solicitor, of Kettering. Three of his brothers became noted. The eldest, Henry, held the Corpus professorship of Latin at Oxford with great distinction. The second, John Trivett, was well known for his accurate and realistic pictures of wild animals, and was the author of the first serious study of Browning. The youngest, Richard Lewis, was a Fellow of Balliol College, Oxford.

Edward Nettleship was born in 1845, and after a preliminary education at Kettering became a student of the Royal Agricultural College at Cirencester, and of the Royal Veterinary College. Though he qualified as a veterinary surgeon, he soon relinquished that branch, and studied at King's College and the London Hospital Medical Schools, taking the Fellowship of the Royal College of Surgeons of England in 1870. He specialised in ophthalmic surgery at a time when most ophthalmic surgeons still practised general surgery. He was appointed surgeon to the South London Eye Hospital, but his real life-work was carried out at St. Thomas's Hospital and the Moorfields Eye Hospital.

At St. Thomas's Hospital that remarkable personality, Liebreich, who still lives an artistic life in Paris, had laid the foundation of an ophthalmic clinic. Nettleship continued his work, and brought it to a state of perfection previously unequalled in England. At Moorfields he had been assistant to the late Sir Jonathan Hutchinson, where he rivalled his teacher and life-long friend in his enthusiasm for clinical work, and in his abounding inquisitiveness into the mysteries of eye diseases.

Papers full of acute observation and accurately authenticated facts came rapidly and continuously from Nettleship's pen. He thus built up a reputation which ranks with that of the greatest ophthalmic clinicians of the past—Mackenzie of Glasgow, von Graefe of Berlin, and Sir William Bowman of London, the founders of modern clinical ophthalmology. His magnetic personality attracted many of the best students to his side, and he thus founded a tradition for careful observation and accuracy of detail which is being carried on by his successors. He did not suffer fools gladly, and his somewhat brusque manner towards them kept his little band select, whilst it unfortunately aroused some enmity in those who had not the opportunity of testing intimately his sterling character and warm friendliness. He built up a very large private practice, one of his most distinguished patients being Mr. Gladstone, on whom he operated successfully for cataract.

About fifteen years ago Nettleship retired from practice and settled down in his country house at Hindhead. It was not a retirement to ease and luxury, but merely a deviation into scientific work little less laborious than his earlier work. He devoted himself especially to the study of heredity, and his painstaking and illuminating researches in this subject require no other testimonial than that they were rewarded by the Fellowship of the Royal Society in 1912.

These are his greatest works, but he was full of lively interest in all that pertained to ophthalmology. Much of his time and energy was given up to colour-vision, and he did most valuable service as a member of the departmental committee of the Board of Trade on sight tests for the mercantile marine.

Mr. Nettleship was somewhat reserved, and only those who gained his confidence and learnt to know him well succeeded in penetrating to the fires of friendship which glowed within him. He has passed away, leaving behind him a record of work which lives and will continue to live.

J. Herbert Parsons.

NOTES.

At the meeting of the Royal Society of Edinburgh, held on November 3, 1913, the following were elected honorary fellows:—Prof. Horace Lamb, F.R.S., professor of mathematics in the University of Manchester; Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S., formerly director of the Royal Botanic Gardens, Kew; Dr. G. E. Hale, director of the Mount Wilson Solar Observatory (Carnegie Institution of Washington); Prof. Emil C. Jungfleisch, Mem.Inst.Fr., professor of organic chemistry in the College of France, Paris; Prof. S. Ramón y Cajal, professor of histology and pathological anatomy in the University of Madrid; Prof. V. Volterra, professor of mathematics and physics in the University of Rome; Prof. C. R. Zeiller, Mem.Inst.Fr., professor of plant palæontology in the National Superior School of Mines, Paris.

The Physical Society's Annual Exhibition will be held on Tuesday, December 16, at the Imperial College of Science, and will be open both in the afternoon and evening.

Announcement is made from Paris that Prof. Charles Richet, professor of physiology in the University of Paris, and member of the Academy of Medicine, has been awarded the Nobel Prize for science.

The eighty-eighth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Prof. H. H. Turner, F.R.S., his title being "A Voyage in Space."

The brain of the late Prince Katsura, which, according to his wishes, has been removed to the Imperial University Museum in Tokio, was found to weigh 1600 grams—the same as that of Kant.

The death is reported, in his seventy-ninth year, of Dr. P. R. Uhler, an American entomologist and geologist of repute. For three years he was an assistant to Prof. Louis Agassiz, at Harvard, and afterward explored parts of the island of Hayti for him. Since

1862 he had been officially connected with the Peabody Institute, Baltimore. Dr. Uhler was the author of many contributions to scientific journals, and his collection of locusts, presented several years ago to the U.S. Government, was considered one of the best ever made.

THE death is announced, at sixty-seven years of age, of Dr. H. F. Parsons, formerly of the Medical Department of the Local Government Board. An obituary notice in *The Times* reminds us that Dr. Parsons served on many Departmental Committees, including those on water, gas, regulations as to cremation, the work of the Geological Survey, and the medical inspection and feeding of children in public elementary schools. He contributed papers to the Transactions of the Epidemiological Society, of which he became president, and to those of other scientific bodies. He was a fellow of the Geological Society, and among his works were memoranda on the sanitary requirements of cemeteries, disinfection by heat, a report on the influenza epidemic of 1899–90, and an examination of the comparative mortality of English districts.

THE jubilee of the practical realisation of the ammonia-soda process by the chemist, Ernest Solvay, was recently celebrated in Brussels, and was marked by munificent gifts of five million francs for scientific purposes by the veteran inventor, who on the same occasion celebrated his seventy-fifth birthday. The Institute of Applied Chemistry of the faculty of sciences at Paris received 500,000 francs, and the same sum was allotted to the University of Nancy to create a chair of electrotechnics. A fund of 500,000 francs was also put aside for a quadrennial prize to be awarded by the International Congress of Hygiene for researches in transmissible disease. On the occasion of the jubilee, M. Solvay delivered an enthusiastic eulogy of pure science and its results, and made the interesting avowal that the pursuit of science was the *rêve doré de toute sa vie,* and had it not been for the necessity of providing for a family he would probably have taken it up as his profession. On the occasion of this jubilee King Albert honoured M. Solvay by naming him a grand officer of the Order of Leopold.

IMPORTANT proposals for another British Antarctic Expedition, to start next year, are made public by a letter to the Press from Sir Clements Markham, and by Mr. J. F. Stackhouse, who is to lead the expedition. The completion of work in the McMurdo Sound region by the expeditions under Shackleton and Scott directs attention elsewhere in the British section of Antarctica, and Sir Clements Markham regards as one of the next most important problems the investigation of the connection between King Edward VII. Land and Graham Land. It is proposed by Mr. Stackhouse to begin his work at the eastern or Graham Land end of the British quadrant, and to follow the coast, hoping to prove or disprove its continuity, and thus to solve a leading question regarding the physiography of Antarctica in outline. The scheme depends largely upon the incidence of an open season, when the ice-pack leaves a passage along the coast; Scott himself held the chances of such an opportunity to be good. Financial support is invited, and headquarters for the expedition have been established at Sardinia House, Kingsway, W.C.

THE National Council of Public Morals has established a private commission to inquire into the extent and character of the decline in the birth-rate, its causes, its effects, and its economic and national aspects. This commission is both a strong and representative one, and the fact that Dr. Stevenson, the Superintendent of Statistics for the Registrar-General, and Dr. Newsholme, Medical Officer to the Local Government Board, have joined it gives one confidence that it will be able to obtain and use in an effective manner the best statistical data available to anyone. It will be remembered that these two authorities published in 1906 a paper on the decline in human fertility, which attracted considerable attention. The commission is also to be congratulated on obtaining as members several well-known lady doctors, including Dr. Mary Scharlieb and Dr. Ettie Sayer, who through their professional work have had special opportunity for studying fertility and its absence from the woman's point of view. Economic science, medicine, law, and journalism are all well represented, and the biological aspects of the questions to be discussed will not be forgotten with Mr. Walter Heape to stand for this branch of science. As might perhaps have been expected, the clerical element somewhat predominates. Bishop Boyd-Carpenter is the chairman of the commission, and the Rev. James Marchant the secretary, and there is besides a galaxy of bishops, deans, and well-known preachers. Among these we are glad to find the Dean of St. Paul's, whose sane and broad-minded treatment of such subjects as eugenics has done so much to focus the attention of serious people on them.

The Falmouth Packet of September 17 contains an account of the recent visit of the surveying ship *Carnegie,* of the Carnegie Institution of Washington, in charge of Capt. W. J. Peters. This is the second visit paid by the vessel to Falmouth for the purpose of magnetic observations, the first having been paid four years ago. From Falmouth the *Carnegie* left for New York, whence she set out in June, 1910. The cruise has extended over a large part of the world, calls having been made at, amongst other places, Rio de Janeiro, Cape Town, Colombo, Mauritius, Manila, Fiji, Falkland Islands, and St. Helena. Its geographical position and the presence of a magnetic observatory have in the past rendered Falmouth a specially favourable port for linking up observations on the Atlantic with land observations in western Europe. The discontinuance of magnetic work at Falmouth has been so recent that its usefulness as a base has scarcely as yet been impaired, but in future years unfortunately greater uncertainty will prevail as to the secular change there of the magnetic elements.

THE opening meeting of the Institution of Electrical Engineers for the present session will be held on November 13, when the premiums awarded for papers read or published during the session 1912–13 will be presented, and an address on pressure rises will be given by Mr. W. Duddell, F.R.S., the president of the institution. In the list of papers to be read at meetings during the first half of the session we notice one by Mr. H. R. Speyer on the development of electric power for industrial purposes in India. The papers in preparation for the second half of the session are to deal largely with electric traction, and great prominence is to be given to the general question of the electrification of railways. The fifth Kelvin lecture is to be delivered by Sir Oliver Lodge on January 22, 1914. Much of the good work accomplished by the institution is done by the local sections, which meet regularly. The local branches which have been inaugurated up to the present are the Birmingham, Dublin, Manchester, Newcastle, Scottish, Western, and Yorkshire Sections. The Newcastle Section sometimes meets at Newcastle, and sometimes at Middlesbrough; the Scottish alternately at Glasgow and Edinburgh; the Western alternately at Bristol and Cardiff, and the Yorkshire Section at Leeds.

THE Natal Sugar Growers' Association has for some time past been in communcation with the Durban Technical Institute with the view of establishing a sugar school, the aim of which would be to prepare young men for the technical control and investigation of the manufacture of cane-sugar. The original scheme was to establish three lectureships—in chemistry, bacteriology, and entomology respectively. These, together with the lectureships already in existence, would supply a good technical training. The three specialists appointed would also conduct research in connection with the processes of manufacture and growth of cane-sugar. A wide field is open in this direction. There are problems in the sugar-house awaiting solution which are of great interest in themselves, and the solution of which will be of prime importance to the sugar industry, as something like 20 per cent. of the available sugar is at present lost. In this field it is hoped that the specialists will do pioneer work. Two lecturers—one in the chemistry and one in the bacteriology of cane-sugar—are soon to be appointed, the appointments in the first instance to be for three years at a salary of 400*l.* per annum in each case. Applications should be sent to Mr. B. M. Narbeth, principal of the Durban Technical Institute, Durban, Natal.

GUSTAF ISAK KOLTHOFF, who died on October 26, in his sixty-eighth year, had considerable reputation as a scientific hunter and as a pioneer in the realistic methods of exhibiting natural groups of animals in Museums. His chief monument is the large cyclorama at Stockholm, known as the Biological Museum, in which, with the assistance of the Swedish artist, Bruno Liljefors, he has presented the Swedish vertebrate fauna under the successive conditions of spring, summer, autumn, and winter. A small, but perhaps more genuinely instructive example of his work in this direction is the Biological Museum at the University of Upsala, in which University he was appointed zoological curator so long ago as 1878. In addition to these and to the museum which, about 1865, he created in the boys' school at Skara, near his own home, Kolthoff was responsible for the installation of six other collections of Swedish mammals and birds in various places in Sweden. He was without scientific training of the academic kind, and picked up the technique of his profession while still a youth in the workshops of the State Zoological Museum. By his own study, however, he became a skilled practical ornithologist and entomologist, and in that capacity accompanied Baron A. E. Nordenskjöld's expeditions to Greenland in 1883 and 1887. He also joined Prof. A. G. Nathorst on his voyages to Beeren Island, Spitsbergen, and King Karl's Land. In 1890 he himself led an expedition to Spitsbergen and north-east Greenland. In addition to many popular accounts of his travels, he was responsible, together with Dr. L. Jägerskiöld, for a work entitled "Birds of the North," which appeared during the years 1895 to 1899. In 1907, at the Linnean festival, he received from the University of Upsala the honorary degree of doctor of philosophy.

IN the Transactions of the Hull Scientific Field Naturalists' Club (vol. iv., Part 5), Mr. T. Sheppard describes the excavation of an Anglo-Saxon cemetery at Hornsea, the objects obtained having been deposited in the Hull Museum. Some of the corpses were buried in the crouched position, which seems to be a not unusual feature in Anglo-Saxon interments in east Yorkshire. Among the "finds" is a series of bronze brooches, similar to examples found in Norway, with very naturalistic representations of horse heads. A bell formed of very thin metal is, from comparison with an example from Papcastle, Cumberland, now in the British Museum, assigned to the Roman period. The "food vases" found are interesting because they are unlike the typical Anglo-Saxon cinerary urns, being quite plain, without any trace of ornamentation, and very similar to ordinary domestic utensils. They evidently contained food when placed with the burials.

IN the October number of *Science Progress* Mr. A. G. Thacker contributes an interesting article on the significance of the Piltdown discovery. The era of *Homo sapiens*, he states, should include the Aurignacian epoch and all that comes after; before that epoch we are among kindred but unfamiliar creatures. He suggests, therefore, that the Aurignacian and three subsequent ages should be classed as Deutolithic, and the previous epochs grouped as Protolithic. A discussion follows of the possible relationships of *Pithecanthropus erectus*, the Java ape-man; *Homo heidelbergensis*, the Heidelberg man; *Eoanthropus dawsoni*, the Piltdown woman; *Homo neandertalensis* or *Homo primigenius*, the Neanderthal man of Acheulian and Mousterian times; and *Homo sapiens*, garrulous man. "The power of speech was a crying need of the advancing primates . . . it was language that transformed the horde into the tribe. The creatures were probably widely dispersed on the earth, whilst they were yet speechless . . . rudimentary powers of speech may thus have been acquired independently by more than one species; and this, not blood-relationship, may have been the explanation of the man-like symphysis of the Heidelberg jaw." On this hypothesis the common ancestor is conceived as possessing a simian mandibular symphysis, a massive jaw, large teeth, and probably a low forehead. From this ancestor the Heidelberg and Piltdown types may have come along diverging branches; the former leading up to Neanderthal man, the latter to *H. sapiens*. The author is strongly inclined to think that both the apes and Pithecanthropus have a low forehead, not because they are degenerate, but because they are immediately descended from monkeys. And even in its more plausible application to Neanderthal man, he views the degeneracy theory with considerable suspicion.

UNTIL quite recently holothurians (sea-cucumbers) were known from the older rocks merely by their hard spicules and plates, which were long ago identified in the Scottish Carboniferous. From certain very fine-grained Middle Cambrian beds in British Columbia there have, however, been obtained impressions of soft-bodied organisms which Dr. C. H. Walcott (Smithson. Miscell. Collect., vol. lvii., No. 3) identified as holothurians, under the generic names of Eldonia, Loggania, Louisella, and Mackenzia. But his determination was not suffered to pass without criticism, and in *Science* of February 16, 1912, Dr. Lyman Clark expressed very strong doubts as to whether any of these genera are really holothurian, stating confidently that Eldonia is not. These criticisms are discussed in the August number of *The American Naturalist* by Mr. Austin Clark, who arrives at the conclusion that, with the exception of Mackenzia, which is regarded as a zoantharian, the original identification is correct, two of the genera being assigned to the existing deep-sea family Elpidiidæ, while the third (Eldonia) represents an allied pelagic family. In bodily form the last-named type recalls a medusa, but the resemblance may probably be regarded as a parallel adaptation to a free-swimming existence.

IN the October number of *Bedrock*, Prof. Poulton replies to Prof. Punnett's criticism of the theory of mimicry in the July number of the same review. After pointing out that de Vries himself holds that small variations may be inherited and selected, he brings instances to show that such transmission does actually occur. The case of *Acraea alciope* is adduced as demonstrating that an incipient mimetic feature may arise as an occasional variation in one part of the area inhabited by a given species, which feature may be further developed in distinctness, and in the relative number of individuals possessing it, in the presence of a distasteful model occupying another part of the range of the mimicking species. These facts, it is contended, support the conclusion that "the mimetic pattern was attained by steps and not suddenly." A more elaborate instance is afforded by *Papilio polytes*, with its two mimetic females. Here, apparently, the pigments of mimic and model have different genetic antecedents. By a detailed analysis of the patterns of the forms in question, and by a comparison of their numerical relation with the non-mimetic form in regions where the respective models are present, rare, or absent, Prof. Poulton arrives at the conclusion that these forms have been derived from the ancestral condition by gradual stages, and that his opponent is not justified in the statement that natural selection is non-existent in so far as concerns the comparative numbers of the mimetic and non-mimetic females of this species.

The Scientific American for October 18 contains an article on earthquakes and the Panama Canal, by Mr. D. F. MacDonald, geologist to the Isthmian Canal Commission. The recent occurrence of two earthquakes in the Isthmian zone has directed attention to a subject that might be of considerable importance with regard to the safety of the canal works. Mr. MacDonald, however, concludes that little danger is to be feared from earthquake disturbances (see NATURE, vol. xcii., p. 174), and he gives two main reasons for his view. The first is connected with the geological structure of the isthmus. Though numerous small faults along the course traversed show that readjustments of the crust have taken place in times past, the district is one from which high mountains and all evidences of recent displacement are alike absent. Again, though a large number of tremors are recorded every month by the Bosch-Omori seismograph at Ancon, the isthmus is entirely free from serious earthquakes. The seismic record of the isthmus dates from the Spanish conquest, and during more than three centuries there have been only two earthquakes of any consequence. One in 1621 destroyed many buildings in Panama, while another in 1882 damaged several buildings and bridges, and in places threw the railway track out of alignment. But neither of these shocks, it is probable, would have damaged seriously even the most delicate parts of the canal.

To *Symons's Meteorological Magazine* for October Mr. R. C. Mossman contributes an article on correlations at St. Helena, the fifth of these interesting investigations. The results are not considered as conclusive, but some suggestive resemblances and contrasts have been disclosed. During the years 1893–1903 there was an undoubted relation between the rainfall in the vicinity of Fort William from January to March, and the mean temperature at St. Helena for the months May to August following, but from 1904–11 the correlation breaks down. A relation could also be traced between the mean temperature at St. Helena during January to April and the mean barometric pressure at Punta Arenas (Magellan Straits) during the four months following, but during the last six years (1906–11) the results, for reasons given, were not very conclusive. With respect to temperature at St. Helena and rainfall at Mexico City, the curves pursued the same course from 1892 to 1898, while from 1899 to 1909 they were the reverse of each other. It will probably be remembered that Dr. W. N. Shaw pointed out (NATURE, December 21, 1905, "The Pulse of the Atmospheric Circulation") an apparent connection between the seasonal variation of wind-force at St. Helena and the rainfall in the south of England.

Vol. x. of "Contributions from the Jefferson Physical Laboratory of Harvard University" consists of reprints of eleven papers on physical subjects which appeared during 1912 in the Proceedings of the American Academy, *The Philosophical Magazine, The Astrophysical Journal,* and our own columns. The researches described have been aided by the Rumford fund of the American Academy, the Bache fund of the National Academy, and the Thomas Jefferson Coolidge fund of the University. More than half the volume is occupied by the researches of Dr. P. W. Bridgman on the thermodynamic properties of liquids at high pressures. To this work, which takes its place as one of the classics in this field, we have directed our readers' attention, as it has been published. Other important papers are those by Profs. Pierce and Evans showing that carborundum crystals possess electrostatic capacity owing to the alternation of insulating and conducting strata within them, by Profs. Kennelly and Pierce, showing how the motion of the diaphragms of telephone receivers affect the impedances of the instruments, and by Prof. Peirce on the maximum magnetisation in iron, to which we referred in our issue for July 24. From this list of first-class work it will be seen that Harvard is not one of those universities which overlooks its duty of increasing knowledge in its anxiety to impart knowledge and test it by examination.

The enzymic activity of the sap of a number of vegetables such as cabbage, onions, ginger, and radishes has been investigated by T. Tadokoro, and the results published in a contribution to the Journal of the College of Agriculture, Tohoku University, vol. v., part 2. The capacity of the sap to induce certain enzymic changes appears to vary widely with the plant, peptolytic action being more pronounced in the case of onions and ginger than in the other six plants studied. Diastase was detected in every case with the exception of onions, and urease was present in ginger and yam-roots, although not to any great extent. Catalase and oxydase action was obtained with each sap, but the power to hydrolyse amygdalin and salicin was confined to that of the yam and cabbages.

At a meeting of the Institute of Chemistry on October 29, the first of two lectures was delivered by Mr. W. P. Dreaper on the research chemist in the works, with special reference to the textile industry. The total gross value in 1907 of the textile materials and fabrics manufactured in the United Kingdom amounted to 333,000,000*l.*, and 1,253,000 persons were employed in their manipulation. On a basis of one chemist for every 2000 persons employed, no fewer than 600 chemists should be utilised in this industry alone, each of whom would deal with an annual gross output valued at more than 500,000*l.* One large aniline dye combine on the Continent already employs 700 chemists. The lecturer insisted that the industrial chemist who remains in his laboratory is lost. Knowledge of chemistry alone is an insufficient equipment; modern research requires a knowledge of physics and the power to apply it. The work of the textile chemist was considered in detail, and specially illustrated by reference to the developments in mercerising and schreinering. The chemist working under industrial conditions at once realises the success achieved by the "rule-of-thumb" man in the past; by systematically studying his methods and seeking to discover points he has not fully realised the chemist may often be able to improve upon them. The nature of the methods and machinery used for producing artificial fibres, and more recently artificial fabrics were reviewed. In conclusion the lecturer dealt with the influence of theory and the chemist's work on actual industrial operations.

Messrs. A. Gallenkamp and Co.'s new catalogue (section 1, part iii.), recently issued, deals mainly with the requirements of engineering chemistry. Fuel calorimeters of all descriptions are dealt with very fully, a special feature being a full description of the method of using each of the better known types of instrument. Gas calorimeters are also well represented, including two self-recording types. Five types of CO_2 recorders are illustrated, including all the instruments in common use, and this is supplemented by apparatus for draught measurement and flue gas analysis. The section dealing with oil testing includes viscosimeters, both the flow and friction types, flash-point and distillation apparatus. Apparatus for iron and steel analysis includes an electric tube furnace, apparatus for the determination of carbon by the wet combustion process, and for the estimation of arsenic, phosphorus, and sulphur. The last quarter of the catalogue is devoted to pyrometers; this includes instruments of every type. The principles utilised in the various instruments and their mode of use are briefly but accurately summarised.

We learn from *The Builder* for October 31 that the Liverpool Corporation has held recently a competition for a sanatorium of phthisis patients. This is one of the first municipal sanatoriums to be tackled by the architectural profession, and it was extraordinary to note the great diversity of planning shown by the thirty-one sets of designs submitted. Tuberculosis sanatorium planning is as yet in its infancy, and this fact accounts for these differences in treatment. It is probable that we shall not arrive at anything like a standard type until several have been built and their actual working arrangements tested. The first premium was awarded to Messrs. T. R. and V. Hooper, of Redhill. In their design, nearly all the blocks are isolated, with the exception of the actual wards; these are combined into one long wing. The children's wards are separate, and comprise practically a small self-contained sanatorium; this block is particularly good, and forms a one-storey bungalow. There is a good deal to be said in favour of aiming at a cheerful collegiate-like character in such a building, rather than going on the lines of the regular and somewhat dreary infirmary type, and this is perhaps the best feature in favour of Messrs. Hooper's design.

Three new volumes in Messrs. T. C. and E. C. Jack's compact little series, "The People's Books," have recently reached us; and they merit a word or two of description in addition to the announcement of their publication, in our weekly list of books received. Mr. E. W. Maunder contributes a popular account of astrophysics in a volume having the title, "Sir William Huggins and Spectroscopic Astronomy." Dr. W. D. Henderson has written a volume on "Biology," in which he gives in language as free from technicalities as possible, a broad account of the main facts of the science of life; and Mr. J. Arthur Hill writes with dignity and philosophic power upon the subject of "Spiritualism and Psychical Research." Each volume contains about 96 pp., and is published at the price of 6*d.* net.

OUR ASTRONOMICAL COLUMN.

Comet News.—The latest comet discovered, namely 1913*e*, (Zinner), has been identified as a return of 1900 III. (Giacobini), so that it has made two revolutions since its original discovery, the period being 6·435 years. Being of about the tenth magnitude and its declination a large southerly one, namely, greater than 19°, it is not a favourable object for observers in high northern latitudes. An ephemeris extending to November 14 is given in *Astronomische Nachrichten*, No. 4690.

Herr T. Banachiewicz, as *Astronomische Nachrichten*, No. 4689, states, reported a light change in comet 1913*c* (Neujmin) on October 6, while on October 8 the comet could no longer be seen. Dr. Graff also looked for the comet in vain.

Writing to the *Astronomische Nachrichten*, No. 4690, on September 11, Prof. Barnard describes an unusual appearance of this comet on September 9. He at first thought that a small star was involved in the north preceding side of the comet, but further observation indicated that the star was travelling with the comet; in fact, it was the nucleus. Using the 40-in. and a power of 460 the nucleus was still stellar, but with 700 it became ill-defined and not so readily taken for a star. He concludes in the following words:—"The nucleus was estimated to be 11·5 magnitude. It was so clear cut and distinctly star-like that one would not for a moment have suspected any real connection with the faint nebulosity apparently attached to it south following. I have not before seen such a striking case of a comet being essentially all nucleus."

Comet 1913*d* (Westphal) does not gain in brightness, as was anticipated, in spite of its distance from the sun being reduced. The following is a continuation of the ephemeris printed in *Astronomische Nachrichten*, No. 4687:—

12*h.* *M.T.* *Berlin.*

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Nov. 6	20 35 17	+27 27·5	8·6
7	34 46	28 2·0	
8	34 18	28 36·1	
9	33 54	29 9·9	8·6
10	33 32	29 43·4	
11	33 14	30 16·7	
12	33 0	30 49·8	
13	20 32 48	+31 22·6	8·7

According to Miss S. M. Levy, of Berkeley, California, the above ephemeris reads about 23 seconds too great in R.A., and about 3·4′ too small in declination for November 13. During the current week the comet passes from Vulpecula into Cygnus, and is in a good position for observation.

Spectra Obtained by Means of the Tube-arc.—Another important spectroscopic research has just been published by Prof. A. S. King (Contributions from the Mount Wilson Solar Observatory, No. 73), who has been studying the relation of the arc and spark lines by means of a tube-arc. In this paper he presents in some detail the leading features of the spectrum of this form of arc, and by a comparison with other sources he infers the probable character of the radiation involved. The results discussed and finely illustrated are based on fifty plates taken with instruments of different degrees of dispersion. This paper follows the one described in this journal in July last (Vol. xci., p. 541), and the main results of the inquiry may be briefly summarised as follows:—In the study of the tube-arc spectrum a region near the centre of the tube's cross-section was found to give the hydrogen spectrum and the enhanced lines of metals most strongly, with some variation among different elements as to how rapidly their enhanced lines diminish in intensity towards the wall. The arc lines of two groups of elements, represented by iron and calcium, show different degrees of response to the conditions most favourable for enhanced lines. The arc lines of titanium and vanadium differ from those of the other elements studied, as they show their greatest strength close to the wall. On the question of dissymmetry of lines produced in the central part of the tube, the dissymmetry is usually towards the red, but some lines show little or no effect. In the cases of λ4481 (Mg.) and λ4267 (C.) the dissymmetry is explained by the observation that both these lines are double. Tests on the ionisation of the vapour and on its conductivity compared to that of the tube material, together with the spectroscopic phenomena of the tube arc, indicate that the effects may largely be due to the impact of electrons emitted by the highly heated carbon, the resultant effect of these impacts becoming stronger near the centre of the tube.

Kodaikanal Prominence Observations and Discussions.—Two bulletins, Nos. 31 and 33, of the Kodaikanal Observatory, have come to hand dealing with the routine observations of prominences and a discussion of past data. No. 31, by the director, Mr. J. Evershed, is confined to the summary of prominence observations for the first half of the present year. Compared with the previous six months the mean frequency remained practically unaltered, while the mean height slightly increased, and the mean extent somewhat diminished. The eastern limb showed a slight preponderance in numbers and areas over the western. Only five metallic prominences were observed. Other observations recorded include the displacements of the hydrogen lines, prominences projected on the disc as absorption markings, &c.

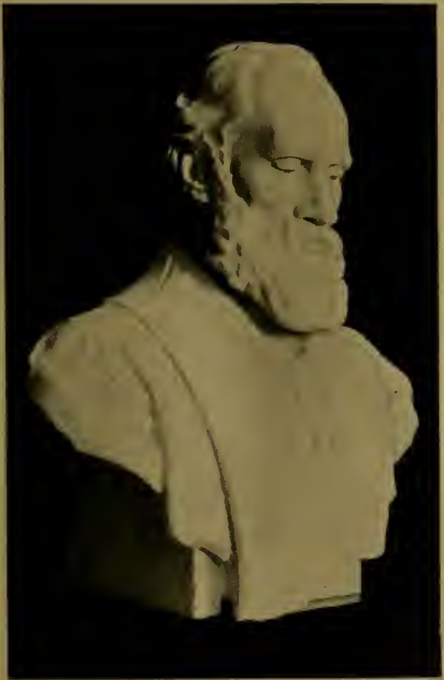
Bulletin No. 33 is written by the assistant-director, Mr. T. Royds, and deals with prominence periodicities, the investigation being a construction of the periodograms of prominences in the same way as Schuster investigated the sun-spot data. Mr. Royds confined the Kodaikanal data to the years 1905–1912, and determined the mean daily areas by dividing the total prominence areas for each month by the effective number of days of observation in each month. The prominence periodogram finally obtained displayed the presence of three periods of large intensity, two nearly homogeneous, of $6\frac{1}{3}$ and $7\frac{1}{2}$ months, and the third, provisionally fixed at $13\frac{1}{3}$ months, the highest of the band. The mean daily frequencies for each month from the year 1881 to 1912, deduced from observations at Palermo and Catania, were similarly analysed, as a check, and they indicate distinct peaks at the same points as the Kodaikanal curve. The amplitudes of these short periods in terms of a percentage of the average of mean daily areas are given as follows:—

Period	$13\frac{1}{3}$ months.	Percentage	13·6
"	$7\frac{1}{2}$ "	"	9·1
"	$6\frac{1}{3}$ "	"	10·1

Mr. Royds concludes by adding that other independent prominence data which are sufficiently complete and continuous are, however, highly desirable in order to establish firmly the reality of these periods.

PRESENTATION OF BUST OF LORD KELVIN.

At the general statutory meeting of the Royal Society of Edinburgh, held on October 27, a marble bust of the late Lord Kelvin, by Mr. A. M'Farlane Shannan, which had been given by Lady Kelvin



Marble bust of Lord Kelvin.

to the society, was formally presented and received. Sir William Turner, the retiring president, occupied the chair, and there was a large and representative gathering of the fellows and the general public. Prof. Crum Brown made the presentation in the name of Lady Kelvin. After referring to Lady Kelvin's thoughtful kindness in giving this beautiful bust as a permanent possession of the Royal Society of Edinburgh, and to his own lifelong friendship with Lord Kelvin, Prof. Crum Brown referred especially to Lord Kelvin's "supreme love of truth and of his intense interest in everything, however apparently trivial, connected with the constitution or with the working of the physical universe. These were the prime motives to his work, and he carried it out in the same spirit. Having formulated a problem, he followed the straightest course to its solution. Of course, he encountered difficulties; these he did not evade, he surmounted them. To do so he had often to invent and construct special instruments of wholly novel type. . . Lord Kelvin was a great mathematician. He was never at a loss to find the mathematical key. . . . Lord Kelvin was no intellectual miser. When in the course of his scientific work he came across something which could be so applied as to be of practical use, he developed this application, and thus became the inventor of instruments, truly scientific instruments, differing in character from those he made for purely scientific purposes only in this, that they were also used and very highly prized by those who were not necessarily scientific, who perhaps did not care about the dissipation of energy or vortex motion. These practical men, by using Lord Kelvin's inventions, came to see that pure science was not vain; they came to know something of the tree from its fruit. Lord Kelvin was quite free from selfishness or jealousy. He rejoiced in his own work and discoveries; he also rejoiced in the discoveries of others. In questions of first importance to man, where science gave no help, Lord Kelvin was a humble and devout disciple. In Lady Kelvin's name I hand over to the Royal Society of Edinburgh, through you, sir, as president, this beautiful work of art and striking likeness of Lord Kelvin, one of the greatest discoverers in pure science, a true benefactor of mankind, our honoured president and dear friend."

In accepting the bust in the name of the society, Sir William Turner referred more particularly to Lord Kelvin as a fellow of the Royal Society of Edinburgh. He joined the society in 1847, and continued so to be for the remaining sixty years of his life. His early communications were on the theory of heat, and their Transactions contained a valuable record of that brilliant work. Numerous communications followed, and his last paper was communicated in 1906, just a year before his death. This was upon the initiation of deep-sea waves, and, as all knew, the sea and the deep-sea formed important features in his practical career. Lord Kelvin occupied the presidential chair for three different periods, from 1873 to 1878, from 1886 to 1890, and from 1895 to his death in 1907. The second period was only for four years, the council of the society relieving him from the full five years at that time in order that he might be able to accept the invitation of the Royal Society of London to act as their president, an arrangement which was carried out by mutual understanding between the two councils. He asked Prof. Crum Brown to be good enough to convey to Lady Kelvin their most devoted and hearty thanks for that admirable bust of her late husband, which would be one of their precious possessions.

ORNITHOLOGICAL NOTES.

To the *Bull. Soc. Imp. Nat. Moscou* for 1912 Prof. P. P. Suschkin contributes an article of more than 200 pages on the bird-fauna of the Minussinsk district of the Upper Yenisei, the Sahan Mountains, and the Urhanchen country, an area of special interest on account of being the meeting-place of several sections of the Eastern Holarctic fauna. To the north and east, for instance, is the realm of the East Siberian fauna, while on the west we enter the great plain of western Siberia, with a fauna differing but slightly from that of Europe. To the southward is the fauna of Central Asia, and, finally, to the south-west that of Turkestan.

The local distribution of the large number of species of birds found in this vast tract is shown in elaborate tables, which indicate not only the area visited by each, but likewise whether this includes steppe, wooded steppe, or alpine country. The paper should be of great value to students of zoological distribution.

In this connection may be noticed a paper by Mr. T. Iredale in the Transactions of the New Zealand Institute for 1912 (vol. xlv.) on the bird-fauna of the Kermadec Islands, in which stress is laid on the affinity between the birds of New Zealand on one hand, and those of New Caledonia on the other. It is suggested that the Kermadec Islands should be regarded as one province of the Australian region, exhibiting marked Polynesian affinities, Norfolk and Lord Howe Islands as a second, and New Caledonia as a third.

Turning to Australia, reference may be made to a coloured plate in the July number of *The Emu*, illustrating the remarkable variation in shape, size, colour, and marking displayed by the eggs of the piping-crow, or Australian magpie (*Gymnorhina tibicen*), which, it is claimed, exceeds that in any other bird. Nine specimens are figured, each from a different clutch, and each more or less unlike the rest, the variation in colour ranging from greenish-blue to reddish and sandy, and the markings from blackish spots to reddish scribblings. In an accompanying note Mr. A. F. B. Hall states that, unlike those of many sea-birds, all the eggs of any particular clutch are practically similar, and this similarity extends to all the clutches laid by each individual bird. This, it may be added, has an important bearing on the theory of "wagtail-cuckoos," "reed-warbler-cuckoos," &c.

Footprints of the larger species of moas are, it appears, but very rarely found, the two chief, if not only, recorded instances of their discovery having taken place at Turangui, Poverty Bay, in 1871, and on the Manawater River, Palmerston North, in 1894. At the latter locality four other footprints were exposed in 1911 by a flood, which washed away a bank 15 ft. high, revealing at its base a bed of clay containing four prints. These are described and figured by Mr. K. Wilson in the aforesaid volume of the Transactions of the New Zealand Institute. The tracks measure 18 in. across the foot, 12 in. from point of middle toe to heel, and 30 in. from heel to heel. Plaster casts have been taken.

In the first number of vol. ii. of *The Austral Avian Record* Mr. J. B. Cleland directs attention to abnormal coloration in the palate and pharynx of certain Australian birds, the variation taking the form of black and grey tints in some groups, and of yellow or orange in others. No suggestion as to the reason for this departure from the normal flesh-colour is suggested.

The autumn number (vol. v., No. 7) of *Bird Notes and News* is illustrated by a reproduction in black and white of an exquisite painting by Mr. H. Grönvold of the white heron, or egret, with the legend, "Where are my companions? Save me." The issue includes a chronological sketch of the movement against the plumage trade, from its rise in 1869 to the present day, with the text of the Government Plumage Bill. Reference is also made to the protection of birds at lighthouses, the slaughter of swallows in France, and bird-catching in this country.

In the October number of *British Birds*, Mr. H. F. Witherby records the results of a series of careful observations made by himself with the object of ascertaining the cause of the baldness of the area round the base of the beak in adult rooks. The investigation also included the moults undergone by the plumage generally. In rooks of the year the area which is bare in their parents is fully feathered; but Mr. Witherby records that a number of hair-like "filoplumes" grow amid the narial bristles, and that larger filoplumes, as well as down-like plumules, are hidden among the contour-feathers of the chin and throat. In the first—July and August—moult the feathers are renewed all over the head in the normal manner, although those on the area which eventually becomes bare are of a somewhat abnormal type. In the following January, however, or somewhat later, the feathers of this area are gradually shed, and not replaced—although most of the filoplumes and plumules persist—while the feather-papillæ undergo an abnormal development into curious pin-like growths over the now permanently bare area. R. L.

THE SYNTHESIS OF GLUCOSIDES BY MEANS OF FERMENTS.

AT the closing session of the eleventh International Congress of Pharmacy, recently held at the Hague, Prof. Emile Bourquelot, of Paris, delivered a lecture on the synthesis of glucosides by means of ferments, in which he described the results of his recent researches on this subject.

Hitherto it has not been proved that enzymes have anything but an analytical action; Prof. Bourquelot, who has been working on the ferments for something like twenty years, has, however, obtained results which justify the conclusion that the decomposing action continues up to a certain point only, and that at this point a synthetic action begins. He gives as an example the action of emulsion on arbutin; one of the products of decomposition is hydroquinone, but the action ceases before the whole of the arbutin is decomposed. This he shows to be due to the presence of the products of decomposition, for when hydroquinone is added to a solution of the enzyme and the glucoside, the decomposing action of the enzyme is greatly retarded.

Having established this fact, Prof. Bourquelot allowed ferments to act upon methyl alcohol in the presence of glucose, and succeeded in forming methylglucoside β. He next dealt with other alcohols, and succeeded in synthesising a series of glucosides, and determined the conditions under which synthesis could be effected. By combining different sugars with the same alcohol, a number of hitherto unknown glucosides was synthesised, and the synthesis of many others is possible.

PHYSICS AT THE BRITISH ASSOCIATION.

THE meetings of Section A of the British Association at Birmingham were of great interest to the general scientific public and of considerable value to those more specially interested in the particular problems discussed and the papers read at the sectional meetings. English physicists, astronomers, and mathematicians attended the meeting in force. Among those who were present may be mentioned Lord Rayleigh, Sir J. J. Thomson, Sir Joseph Larmor, Prof. Rutherford, Prof. Bragg, Prof. Poynting, Prof. Hobson, Prof. H. H. Turner, Sir D. Gill, Dr. Glazebrook, Principal E. H. Griffiths, Prof. Lamb, Prof. Love, Prof. S. P. Thompson, and Mr. J. H. Jeans. A distinguished company of foreigners also attended, amongst whom were Madame Curie, Prof. H. A. Lorentz, Prof. E. Pringsheim, Prof. Arrhenius, Prof. R. W. Wood, and Dr. Bohr. With the president of the association a physicist, and Dr. H. F. Baker as sectional president, the *personnel* of the meeting was of great interest in itself, and in consequence the papers and discussions were of a very high order of excellence.

The address of Sir Oliver Lodge was of special interest, as in it he touched on the main subjects of discussion in the section. The address has been published in full in an earlier number of NATURE, so that there is no need for further remark here. The sectional president's address has also appeared in full in NATURE, and there is similarly no call to deal with it further in this place. It was listened to by a crowded audience, and formed a fitting opening to a meeting that proved itself of great importance, and in which the interest was kept up till the last day.

The address of Dr. Baker, after a vote of thanks proposed by Sir Oliver Lodge and seconded by Lord Rayleigh, was followed by a paper by Prof. Barkla on the nature of X-rays. This subject has practically ceased to be controversial except as it has passed over into the general subject of radiation. Prof. Barkla gave an outline of the evidence in favour of the undulatory theory, of which he has always been a keen exponent, and which is now accepted by all physicists. Sir J. J. Thomson and Prof. Rutherford spoke in the following discussion, the former paying a well-deserved compliment to Prof. Barkla on the large amount of our knowledge of X-rays which is due to him. Prof. Rutherford laid stress on some of the still outstanding difficulties in the subject. The discussion was not so interesting as it would have been a year ago, when the supporters of the corpuscular theory would have been in force. This paper was followed by one from Sir J. J. Thomson on the structure of the atom. This was a brilliant attempt to construct an atom which would account for some of the evidence for the quantum theory of energy. The paper was delivered with the clearness and boldness now always expected from Sir J. J. Thomson, and it will be long before his illustration of the quantum theory by pint-pots is forgotten.

The next paper was by Prof. H. A. Lorentz. Prof. Lorentz is known to all physicists as the leading exponent of all questions involving the interactions of æther and matter. His presence at the Birmingham meeting added greatly to the interest and value of the discussions. His command of English, his extraordinary capacity for exposition, and his quiet humour made his paper and his speeches in discussion one of the most enjoyable features of the proceedings of Section A. The subject of the paper was, "The Relation between Entropy and Probability." The entropy of a body in a certain state is intimately connected with the probability of that state. Boltzmann has deduced the expression of the relation in his well-known formula, in which the entropy is proportional to the logarithm of the probability of the state. Prof Lorentz's paper was to investigate how the probability is to be evaluated. The method of calculation, closely connected with Gibbs's microcosmical ensembles, gives the entropy of Boltzmann's formula as the thermodynamical entropy. On account of the enormous number of molecules contained in a body, Boltzmann's formula has the remarkable property that great changes in the value assigned to the probability have no appreciable effect on the entropy.

A special case considered was that of a monatomic gas. If the number of molecules is n, P the probability $= Cv^n e^{\frac{3n}{2}-1}$. C being a determinate constant factor; hence if we omit the corresponding term in the entropy S, this $= n\frac{R}{N}\log\left(ve^{\frac{3}{2}-\frac{1}{n}}\right)$, which since n is very large $= n\frac{R}{N}\log\left(ve^{\frac{3}{2}}\right)$, an expression which is neither very large nor very small when the mass of the gas is comparable with a gram-molecule. Now it is clear if P be multiplied by n, or even a high power of n, say n^{100}, this produces no appreciable effect on S, for $\log n$ is very small compared with n for large numbers. Boltzmann's formula is therefore insensible to such factors as n^{100} in the value of P. Again, if the n molecules be supposed distributed at random over a volume v, the probability that they all lie in one half of it is $\frac{1}{2^n}$, whereas it is 1 if all possible distributions are considered. The corresponding difference in the entropy is no more than $n\frac{R}{N}\log 2$. The result of this property is that we are to a large extent free in the choice of a value of P. Thus, in order to calculate the entropy, we may as well take the probability of the most probable state of things as the much higher value that is obtained if all possible states are included.

After Prof. Lorentz, another paper on the structure of the atom was read by Prof. Rutherford. The author took the opposite view to that represented by Sir J. J. Thomson's atom. The Rutherford atom consists of a charged nucleus of minute dimensions, in which most of the mass is concentrated. This nucleus is surrounded by a distribution of electrons. The evidence for this structure of atom lies in the large angle scattering of high-speed particles like the α and β particles from radio-active matter. New experiments were described by Prof. Rutherford on the scattering of α particles by the simple gases. It was unfortunate that there was no time for a fuller discussion of the interesting points raised by this paper and that of Sir J. J. Thomson.

The last communication, taken on Thursday, was one by Dr. Swann—who has just left Sheffield for America—on the resistances of thin metallic films. Some of the hitherto unexplained facts in connection with the conductivity of thin films were explained on the hypothesis that the film deposited by the electric discharge does not consist of a continuous and homogeneous distribution of molecules, but of patches or groups of molecules more or less definitely separated from each other. This distribution was taken account of in the paper, and a formula calculated to allow for the resulting alteration in the mean free path of electrons concerned in conduction. The agreement of the theory with experimental results is as close as could be hoped for.

On Friday morning the most important discussion of Section A, if not of the whole meeting, took place. The subject was radiation, and it was opened by Mr. J. H. Jeans in a masterly and concise manner. The discussion turned on the question of the validity of the laws which have hitherto been believed to be the ultimate laws of nature. The problem at its simplest occurs in the case of black body radiation. Mr. Jeans regarded the work of Poincaré as conclusive when starting with the mean energy of each vibration of specified wave-length he deduces the quite definite result that the exchange of energy must take place by finite jumps. This leads directly to the quantum hypothesis which the opener assumed in its entirety. He went on to consider what other phenomena bear witness to its truth. The most important is the photoelectric effect: the energy imparted to an electron appears to be exactly the right amount required by the quantum hypothesis. Mr. Jeans quoted in this connection the recent work of Dr. Bohr, who has arrived at a convincing and brilliant explanation of the laws of spectral series.

Against the quantum theory seem to be arranged most of the well-established results of the undulatory theory of light. The great difficulty is the reconciliation of the two sets of facts. The boldest and simplest attempt lies in abandoning altogether present conceptions of the æther, and relying on some purely descriptive principle, such as relativity. But the attempt at a dynamical explanation should be made, and Mr. Jeans concluded by a suggestion as to the meaning of the Planck constant h. This constant is connected with e, the charge of an electron. We may, perhaps, imagine that the equations of the æther involve e or h as well as the Maxwell terms. These terms may be eliminated in forming the equations for wave propagation for certain cases, and in that event there will be no discrepancy between the quantum theory and the undulatory theory. But where the equations are applied to interactions between matter and æther, the older theory will not apply, and the terms involving h must remain in.

The second speaker was Prof. Lorentz. He accepted the quantum theory, and sought a method of accounting for it. Some kind of discontinuity in the transfer of energy is experimentally proved, but the individual existence of quanta in the æther is impossible. He considered the scheme of transference of energy from matter to resonators and to the æther. The transfer from a resonator to the æther of a quantum can be easily conceived, but it is difficult to understand how the quantum can be transferred back to the resonator from the æther, for once in the æther it becomes distributed indefinitely. Prof. Lorentz suggested that the quanta are necessary in some transference, and that perhaps the solution was to be found in assuming them operative in transferences from matter to the resonator and *vice versa*, and not in the interchange between resonators and the æther. The difficulty in this view is to distinguish clearly the two classes, matter and resonator. Prof. Lorentz was again clear and very interesting. His humour again appeared, as when referring to Sir J. J. Thomson's atom he remarked that "it was highly ingenious—as it could not otherwise be—but the point was, did it represent the truth?"

Prof. Pringsheim followed, and confined his remarks to the experimental bearing of the problems raised. The constants of radiation are not accurately enough known—for example, Stefan's and Planck's constants. He also referred to the question of the radiation from other sources than the black body. Dr. Bohr, of Copenhagen, was the next speaker. His work had been referred to by previous speakers, and he gave a short explanation of his atom. His scheme for the hydrogen atom assumes several stationary states for the atom, and the passage from one state to another involves the yielding of one quantum. Dr. Bohr also emphasised the difficulty of Lorentz's scheme for distinguishing between matter and the radiator. Planck's resonator has all the ordinary properties of matter, and it is difficult to keep up the distinction. Prof. Lorentz intervened to ask how the Bohr atom was mechanically accounted for. Dr. Bohr acknowledged that this part of his theory was not complete, but the quantum theory being accepted, some sort of scheme of the kind suggested was necessary.

Prof. Love represented the older views, and maintained the possibility of explaining facts about radiation without adopting the theory of quanta. He criticised the application of the equi-partition of energy theory, on which part of the quantum theory rests. The evidence for the quantum theory of most weight is the agreement with experiment of Planck's formula for the emissivity of a black body. From the mathematical point of view, there may be many more formulæ which would agree equally well with the experiments. A formula due to A. Korn was dealt with, which gave results over a wide range, showing just about as good agreement with experiment as the Planck formula. In further contention that the resources of ordinary theory are not exhausted, he pointed out that it may be possible to extend the calculation for the emissivity of a thin plate due to Lorentz to other cases. For this calculation no simple analytical expression represents the results over the whole range of wave-lengths, and it may well be that in the general case no simple formula exists which is applicable to all wave-lengths. Planck's formula may, in fact, be nothing more than an empirical formula. Lord Rayleigh spoke next. He did not attempt to discuss the question, but welcomed the discussion. It was interesting to see Lord Rayleigh at the meeting, and references to his historic work on the subject of radiation were made by several of the speakers.

Sir J. Larmor spoke about the theory of the equipartition of energy. In an isolated region of the æther there is no way open for the interchange of energy at all between one type of radiation and another, so that the assumption of "other things being indifferent" is not applicable. The structure of an electron and the mechanism by which it reacts with the æther is totally unknown. In the very intense kinetic phenomena which occur when transferences of energy take place, the energy may not be expressible as a sum of squares, as the equipartition theory requires. A transfer may be even discontinuous. Sir J. Larmor went on to show that equi-partition need not therefore be necessary as regards free radiation, and atomic vibrations which are set up by its agency and must be in equilibrium with it need not come under the equi-partition theory. The new knowledge we have of specific heats at very low temperatures has also led to further speculations and extension of theoretical schemes, but it can be held that there is nothing destructive of older principles of physics. He looked to a reconciliation between the older and newer views from further knowledge of the interactions between free æther and electrons.

Sir J. J. Thomson further discussed the equipartition theory, and was prepared to give it up if it was the cause of all the difficulty. Referring to statistical methods, he recalled De Morgan's saying that if a calculation in probability required more than half a sheet of notepaper, its result should not be received without further independent evidence.

Sir Oliver Lodge spoke also, and pointed out that the ordinary laws could not apply in the interior of an electron or a positive charge, for if they did the charge would fly to pieces because of the mutual repulsion of its parts.

Prof. Lorentz again spoke, and remarked that a theory that explained both the phenomena of specific heat and the absorption spectrum was not to be disposed of on purely mathematical grounds. He emphasised the fact that the Planck constant was there, and that it had some very definite meaning which had to be interpreted.

Dr. S. D. Chalmers gave an account of an atom model which agreed with the results of the quantum theory, and also with the magneton hypothesis. Mr. Jeans closed the discussion with replies to some criticisms, and again pointed out that from the experimental point of view Prof. Lorentz's discrimination of matter and radiators was impossible. No distinction between them could be made.

This discussion went on from ten o'clock to one, and the interest was kept up till the end. It was of great value, as all points of view were represented, and gave a much clearer notion of the trend of thought on this fundamental subject to those who have not been able to follow the literature very carefully. We understand that the discussion is to be published in full in the reports. This will be a valuable addition to the literature of the subject.

Sir Joseph Larmor gave a short account of a paper on lightning and protection from it. He discussed the relation of the field of force near a lightning conductor and the mechanism of the discharge. It was unfortunate that there was only a few minutes for the subject, as there was no discussion, and the views brought forward were of great practical importance. It is to be hoped the paper will appear in full and will have the attention it deserves.

Prof. W. H. Bragg spoke on X-rays and crystals, which was of great interest and importance. The paper was discussed at a special meeting of the section on Tuesday afternoon. It was unfortunate that some of those most interested—Profs. Pope, Barlow, and Armstrong, for example—were unable to be present at the discussion. Prof. Bragg gave an account of the new method of using characteristic Röntgen rays and crystals. With his son, Mr. W. L. Bragg, he had obtained as many as five orders of spectra by reflection at certain planes of the crystals. If in a crystal there are planes specially rich in atoms, these planes, spaced at definite distances, act somewhat in the manner of an echelon grating, and spectra are produced. From the characters of the spectra of different orders—absence, diminished intensity, and so on—the spacing of the planes can be determined, and so we have a new method of determining the arrangement of atoms in crystals. The diamond has been thoroughly examined, and a model of its structure was shown. The method is a singularly beautiful one, and apparently not open to criticism. The method also provides, in the words of Prof. Bragg, a spectroscope for X-rays, and measurements could be made without doubt to an accuracy of 1 part in 1000. For the discussion of the paper Prof. Bragg specially came back to Birmingham and gave further details of the method. Prof. Arrhenius congratulated the authors, and remarked that it was the beginning of a new crystallography. Reference was made to the work of Pope and Barlow, and Prof. Bragg explained that in his view the differences between the structures obtained by the new method and by the old might be reconciled. He made no claim to have contradicted the work resting on the theory of close packing. The paper and discussion were listened to by large audiences, and formed one of the most interesting parts of a successful meeting.

On Friday, after the radiation discussion, the department of mathematics met separately, when two papers on mathematical physics were read. Prof. Eddington spoke on the dynamics of a globular stellar system. The problem attacked is that of the determination of different possible distributions of velocity which correspond to a steady state. In the paper a number of simpler cases are worked out. It is of special interest to find a system in which there is a strong preference for motion to and from the centre (following Prof. Turner's suggestion for explanation of the two star streams). Systems satisfying this kind of motion, and also requiring only a finite density at the centre of the system, have been found. The other paper at this meeting was by Dr. Swann on the expression for the electrical conductivity of a metal deduced from the electron theory.

On Monday the department of general physics held a joint discussion with Section G (engineering) on the investigation of complex stress distribution. This discussion was more on the engineering side than the physical, and will be dealt with in the special article on the proceedings in Section G. The department of cosmical physics met at the same time, and several important papers were contributed. Mr. C. E. St. John, of Mount Wilson Observatory, gave an important account of some late results of solar work at Mount Wilson. He made out a clear connection between the radial velocity of gases in the solar atmosphere and the intensity of the lines which are used in the velocity determinations. That is to say, a connection has been demonstrated between radial velocity and the level in the solar atmosphere. The displacements of Fraunhofer lines in the penumbræ of sun-spots thus is shown to give a means of sounding the solar atmosphere and of assigning relative levels to the sources of the lines. The results obtained clearly open a wide field for further solar research.

Dr. S. Chapman gave an interesting paper on the lunar influence on terrestrial magnetism and its dependence on solar periodicity. On Schuster's theory of the variation of magnetic force Dr. Chapman considered the effect of the lunar tide in the earth's atmosphere. This effect can be detected in the observations. The solar effect is due to the ionisation and conductivity in the upper atmosphere depending on the sun's hour angle. The study of the lunar period is valuable, as it enables us to separate the two effects, periodicity in the atmosphere and periodicity in the conductivity. No apparent relation has been detected between the conductivity and the eleven-year solar cycle. A paper on solar and terrestrial magnetic disturbances was read by the Rev. A. L. Cortie, S.J.

Two interesting papers on meteorology were read—Mr. J. I. Craig on a temperature see-saw between England and Egypt, and on temperature frequency curves by Mr. Gold and Mr. F. J. W. Whipple. There were two papers on seismology: "The Distribution of Earthquakes in Space and Time," by the Rev. H. V. Gill, S.J.; and "Notes on the Construction of Seismometers," by the Rev. W. O'Leary, S.J. A communication of general interest was read by Dr. J. S. Owens, dealing with methods for measuring the amount of atmospheric pollution by suspended matter, such as smoke and dust. Prof. H. H. Turner gave a paper on the Fourier sequence as a substitute for the periodogram. Mr. J. H. Reynolds's communication on arrangements for a reflecting telescope was taken as read. After the joint discussion, the department of general physics met for another important session. Prof. Pringsheim gave his paper on a theory of luminescence and the relation between luminescence and pure temperature radiation. It was interesting to the section to hear in Prof. Pringsheim another distinguished foreign visitor, and one whose name is intimately connected with the experimental results that form the foundation of the new theories of radiation.

The next paper was by Prof. R. W. Wood, of Baltimore, who is well known as one of the most brilliant experimentalists of our day. He described some experiments on resonance spectra under high dispersion. As is expected of Prof. Wood, most interesting and amusing details of experiments were related. The method of removing spider-webs from the long buried tube of the spectrograph by sending "the household pussy cat" through is an original and effective method of attaining the desired end. Amongst the many interesting details of the work, which will be fully described elsewhere, may be mentioned the method of exciting the resonance spectrum of iodine by monochromatic illumination filtered through bromine vapour to supply light of a small enough range of wave-length to include only one line of the iodine spectrum. The paper was full of the kind of experimental perfection that is to be found in so much of Prof. Wood's work.

Prof. S. B. Maclaren gave a paper on a theory of magnets. This paper dealt with some of the difficulties of magnetic theory, and pointed out how an explanation of paramagnetism and diamagnetism may be arrived at. Magnetic induction is explained by means of tensions in the field acting on matter, and the molecular magnetic field is not explained as due to the circulation of electric current sheets. Prof. Coker gave a demonstration of large polarising apparatus for lantern projection. Beautiful pictures result, but the apparatus has been described before, and there is no need for details in this place.

In the middle of the same morning the department of pure mathematics met, when communications were read by Prof. J. C. Fields, Prof. Hilton, Lieut.-Col. Allan Cunningham, Prof. A. C. Dixon, and Mr. M. D. Hersey. A paper by Prof. A. W. Conway was taken as read.

On Tuesday morning there was a joint meeting with Section E (geography), when four papers on geodetic subjects were read. An account of this joint meeting will appear in the article describing the work of the geographical section, which will shortly be published in NATURE. At the same time the department of general physics met and had another series of important papers and discussions. Dr. W. H. Eccles read an account of some experiments on contacts between electrical conductors. The paper explained the absence of a linear relation between current and electromotive force when the current passes across a "loose contact." The behaviour of the contact was explained by purely thermal actions in the matter near the point of contact. The Joule, Peltier, and Thomson effects all play a part.

Prof. Poynting read a paper on the twisting of indiarubber. By means of an exceedingly delicate piece of apparatus he had measured the changes in length and cross section of steel and copper wires under torsion, and had tried the same with indiarubber. Indiarubber showed no observable change in volume when twisted, but a very large increase in length when compared with steel. Sir J. J. Thomson, in discussing the subject, suggested a connection in the behaviour of these materials under magnetic influence.

Two papers—one by Sir J. J. Thomson on X_3 and the evolution of helium, the other by Mr. F. W. Aston on a new elementary constituent of the atmosphere—created great interest. A number of chemists came to hear of this fresh invasion of their territory by Sir J. J. Thomson. The gas X_3, which has been described before, is now considered by Sir J. J. Thomson to be H_3. Evidence was given in the paper which though in detail perhaps not convincing, yet has great cumulative weight. The chemists present were prepared to accept the possibility of an H_3 molecule. As to the evolution of helium, there seems little doubt that it comes from the material bombarded by the kathode rays in the tube. Here there is a divergence between the views recently put forth that such helium results from a transformation of the gas in the discharge tube. In the discussion Sir Oliver Lodge emphasised the importance of these experiments, as in his opinion it was the first case of the artificial production of atomic disintegration. Mr. Aston dealt with an investigation of the existence of an element with atomic weight about 22. Sir J. J. Thomson's positive ray method had detected such an element, and the paper was an account of the partial separation of neon into two gases of approximate atomic weights, 19·9 and 22·1. The method was one of diffusion attested by a change of density. The method of determining the density was by means of a specially constructed quartz balance of small size hung inside the tube containing the gas. By adjustment of the gas pressure the quartz beam could be balanced and the density of the gas determined with great accuracy. The smallness and compactness of the apparatus enabled very small quantities of gases to be dealt with. No physical differences except in density had been discovered between the two gases.

Dr. E. E. Fournier D'Albe gave an account of the minimum quantity of light discoverable by selenium. Very faint illuminations can be detected, and it was suggested that there might be a possibility of direct measurement of the Planck quantum of energy. A paper by Mr. H. B. Keene on the transmission of X-rays through metals was of interest, especially as it was allied to Prof. Bragg's paper on X-rays and crystals. Other papers were by Mr. J. F. Forrest on the electric arc as a standard of light, and by Dr. G. A. Shakespear on the resistance of air to falling spheres and on a method of increasing the sensitiveness of measuring instruments. The method was to throw the image of a Nernst filament lamp from the mirror of any deflected instrument on to a radio-micrometer strip; any change in the direction of the original reflected beam of very small amount results in a large deflection of the radio-micrometer. The method can be repeated, and any increase in sensitiveness obtained except for the difficulty of keeping steady conditions. Mr. J. S. Anderson described a new method of starting mercury lamps. Papers by Mr. W. H. F. Murdoch on a magnetic susceptibility meter, Mr. A. J. Lotka on a new process for enlarging photographs, and Prof. H. Stansfield on the sensitiveness of the human skin as a detector of low-voltage alternating electrostatic fields were taken as read. The discussion on Tuesday afternoon of Prof. Bragg's paper has already been referred to.

On Wednesday the first business was the presentation of reports. On the report of the Seismological Committee Prof. Turner spoke of the loss to seismology and science generally in the death of Prof. John Milne. The work of British seismology and seismology generally owes nearly everything to Milne; as a resolution of the committee expressed it, he may be said to have created a new science. For many years past he had himself presented the annual report of the Seismological Committee, and the report presented by Prof. Turner had been drawn up by him just before his death.

After the reports, papers were read by Mr. J. S. Anderson on a new method of sealing electrical conductors through glass, and by Mr. J. J. Shaw on a seismograph. This instrument had been exhibited during the meeting, and was of the Milne type, with its natural oscillations damped by means of an aluminium strip attached to the boom swinging between the poles of magnets. The instrument is of importance, and had a further interest in the fact that it was designed and constructed with the cooperation of Prof. Milne just before his death. Papers by Dr. Vaughan Cornish on a method of determining the period of waves at sea, by Mr. Lotka on the dynamics of evolution, by Mr. Hookham on microscope crystals with epidiascope illustrations, and by Prof. T. R. Lyle on the Goldschmidt dynamo were taken as read. It was unfortunate that Dr. Vaughan Cornish, owing to a misunderstanding, arrived just after the sectional meeting was formally closed, but an informal meeting was held, which heard the paper with interest.

The meetings of the section were well attended all through, and on several occasions the room, although holding 350 people, was not large enough for those who desired to hear certain papers. The programme was too crowded, and there was not sufficient time for discussion. The remedy is in the sectional committee's own hands. Two afternoon sessions in the week would remove all congestion, and it is difficult to see why Section A should not adopt a course followed by several other sections. This course was urged by the Recorder at the Committee, but rejected. The experiment of a discussion of a particular paper—Prof. Bragg's—in the afternoon was a complete success, and to hold such afternoon meetings would be a better method than to restrict the number of papers contributed. It would be a loss to the usefulness of the section if less important papers were altogether crowded out. One function of the association is to provide some opportunity and encouragement to younger and less well known men, and it would be a pity for such a function to be lost altogether.

Some important work was done in the sectional committee and in research committees. The report of the Seismological Committee has been already referred to. The Seismological Committee had to consider what steps should be taken in order to carry on the work that has hitherto been done under Prof. Milne. It was felt that it was impossible to raise enough money to carry on the work at Shide as an independent station, and the committee decided to try to obtain sufficient funds to enable the observational work to go on. Prof. H. H. Turner undertook to exercise a general supervision over the station at Shide, and for the present this seems a satisfactory arrangement. But it is unfortunate that the work cannot be carried on with proper equipment and *personnel*. Seismology owes so much to Milne that it would be a fitting tribute to his memory for his observing station to develop into a thoroughly equipped institution. In the meantime, the subject is under great obligation to Prof. Turner for taking over the general supervision.

A report was received from the Electrical Standards' Committee announcing its own dissolution. This committee has done immensely important service in the past. Its work has appeared in a more readily obtainable form. The reports from 1861 to the present time are republished in one volume. Prof. H. H. Turner moved a resolution calling attention to the historic character of this committee, and expressing on behalf of the Committee of Section A the sense of its importance and value. Dr. Glazebrook, the secretary of the Standards' Committee, replied.

An important research committee on radiotelegraphic investigations presented its first report and outlined a programme of work. Certain problems, especially those of "strays" and of the differences between night and day signalling, can only be investigated by cooperative work at widely scattered stations. The committee has obtained the cooperation of most of the large institutions connected with wireless telegraphy, and hope that exceedingly valuable work may be done in the near future. Both this committee and the seismological committee hope to be able to carry on their work by means of grants from the Caird Fund.

Reports were also received from the committees for investigation of the upper atmosphere, for the tabulation of Bessel and other functions, for the establishment of a solar observatory in Australia, for administering a grant for the international tables of constants, and for the disposal of "the binary canon." The list of grants made to research committees has already appeared in the columns of Nature.

The local arrangements for the meeting of the section were admirable. The rooms devoted to Section A were in the Mason College, and served their purpose excellently. The large room on some occasions was not quite large enough, but it would be difficult to find anywhere a suitable lecture-room to hold the number who would have liked to hear some of the papers. Great credit is due to those who had the arrangements in hand, especially to Dr. Shakespear, for the smooth working of such a large and complicated section. A word of congratulation may also be given to *The Times* for the excellent way in which some of the meetings, especially the radiation discussion, were reported.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—A course of ten lectures on social anthropology, by Mr. A. R. Brown, of Trinity College, Cambridge, has been arranged for the winter and spring terms. This course is the outcome of a suggestion made in the Anthropological Section of the British Association during the recent meeting, and is intended as a tentative experiment to determine to what extent there is a demand for such a course in addition to the existing course in physical anthropology.

Cambridge.—Mr. W. E. Hartley, of Trinity College, has, with the consent of the Vice-Chancellor, been appointed chief assistant at the observatory.

Mr. F. W. Aston, of Trinity College, has been elected to the Clerk Maxwell scholarship.

Mr. T. L. Wren and Mr. F. Kidd have been elected to fellowships at St. John's College.

An examination for the award of the Sheepshanks astronomical exhibition will be held in the Lent term, 1914. The exhibition is open to all undergraduates of the University of Cambridge, but any person elected, if not already a student of Trinity College, shall thereupon become a student of Trinity College. Candidates may offer themselves for examination in one or more of the following subjects :—(*a*) astronomy and allied subjects as defined in Schedule A of part ii. of the mathematical tripos; (*b*) spherical astronomy and combination of conservations; (*c*) celestial mechanics; (*d*) use and optical theory of astronomical instruments; (*e*) astrophysics. A paper of essays on astronomical subjects and an examination at the observatory in elementary practical astronomy will be compulsory on all candidates.

Among numerous bequests under the will of the late Dr. F. G. Smart is one of "10,000*l*. to Gonville and Caius College, Cambridge, for two 'Frank Smart Studentships' in natural history or botany, and if this sum shall be more than sufficient to provide for these studentships the balance is to be used to promote the study of these subjects in that college."

Mr. J. A. Pease, President of the Board of Education, speaking at Camberwell on October 31, forecasted largely increased grants from the Treasury for education. In the course of his remarks he said :—"Local authorities know only too well that educational expenditure has increased and is increasing, and I must tell them that it will have to increase still farther if we are to get the economic equivalent for what we spend. The gravest of all defects in our educational system is not in elementary education, but in intermediate education. Every child in the country has an equal chance of developing his abilities up to a certain point. It is when that point is reached and passed that the defects of our present system make themselves manifest. You keep a child at school for eight or nine years, and just at the critical time when his natural aptitudes are taking their bent and his character is forming his education is broken off, and the boy and the girl who might have done good service in some profession or skilled industry drops into idleness or loafing, or adds one to the millions of casual and unskilled labourers. I say with conviction that the first upward step must be the improvement of our intermediate education, because that is the branch in which we are most lacking. You may not always find a genius—a genius is rare—but remember that if you do find him you will have repaid yourselves more than a hundredfold. Remember the economic value of a great inventor covers the educational expenditure of a whole town. I think Sir Henry Bessemer was a fellow-townsman of yours here in Camberwell, and Sir Henry Bessemer's chief invention, we know, was equal in productive power to the labours of a hundred thousand men. Now, that is why I say that we must be prepared for further expenditure if we are to get the economic equivalent for what we have spent already. We must be prepared as a country to foot the bill, just as the Government will be prepared to make the proposals to the country. The Government policy is a large policy, and I may say that it is our intention not only to increase the amount of the grant, but to change the manner of its distribution, so that of two areas equally efficient the poorer will receive the larger grant, and of two areas equally necessitous the more efficient will receive the larger grant."

A SUGGESTIVE paper was read by Mr. Cloudesley Brereton at a conference of employers of labour on October 28, in connection with the recent National Gas Congress and Exhibition. Mr. Brereton pointed out that although until recently education in England has busied itself far too little, upon the whole, with the problems of the work-a-day world, yet even the older English Universities of Oxford and Cambridge in actual practice have always been to a considerable extent technological institutions. Their work has been mainly, not so much the imparting of book knowledge, but of "mancraft," the art of handling men, gained through daily contact with their fellows. In so far as the studies of candidates for theology, medicine, and law are concerned, these Universities are to all intents and purposes purely technological colleges. At the present time in the older, and to a far greater extent in the younger, universities we find training in technique provided in many subjects, not merely in law, medicine, and theology, but also in engineering, applied chemistry, the textile industries, gas and electricity, and certain branches of commerce. Whatever the grade of educational institution may be the problem of suitable curricula can only be solved by first considering what will be the probable career of the pupil. The elementary school is already moving in the direction of first diagnosing the pupil's future needs and then prescribing for him. Even the older universities and the public schools are showing signs of being affected by similar influences. Employers, in consequence of the increasing pressure of competition and the invasion of industry by science, are as vitally interested in the production of pupils of the right type as the educationist is, or ought to be. Mr. Cloudesley Brereton gave a valuable summary of the principal steps which have been taken by employers to foster the continued education of their employees, *e.g.* by the award of prizes for attendance and success at examinations, the payment or repayment of fees, making attendance at evening classes compulsory upon junior employees, meetings at works during the hours of employment, and the formation of advisory committees containing representatives of employers and workmen. Important educational results are accruing from such organised schemes of training as those at Sunderland for engineering apprentices, and at the Bournville works. With regard to the question of raising the age of attendance at school to sixteen or seventeen, he suggested that one great difficulty, apart from the cost, is the growing dissatisfaction with the mainly literary type of education, and the conviction that our present system does not give value for the public money now granted.

AT the distribution of prizes to successful students of the City and Guilds Institute at the Mansion House on October 29, the President of the Board of Education delivered an address. Mr. Pease dealt with the question of a worthy university for London. He said that the Government, after careful consideration, has decided that the scheme set out in the report of the recent Royal Commission is calculated to produce a University of London worthy of the name. Everything possible is to be done to carry out the scheme with all reasonable dispatch. To this end a Departmental Committee has been appointed. The underlying principles of the Commission's scheme are to be regarded as accepted. Modifications in detail and machinery may be found desirable, but the fundamental principles must be accepted if any advance is to be made now. If London shows that it is anxious and willing to have a reconstituted University on the lines laid down in the report of the Royal Commission, the Government will play their part in supplying the money necessary. Continuing, Mr. Pease said:—"The whole history of the development of modern universities shows that the prime essential of success is local patriotism. Local patriotism means, of course, money, but it means a great deal more besides. It implies a belief in the necessity for a great university and in the immensity of the influence the university can exercise—an influence which, especially in the case of an Empire metropolis, must always extend far beyond the narrow limits of the area which the university primarily serves. Its functions will be Imperial, even international, as well as local. But without the active support and confidence of the locality no modern university can exist, let alone flourish. Acts of Parliament and State-aid cannot alone create a university." In the case of the University of London, Mr. Pease laid it down that the principles on which any permanently satisfactory scheme must be based are simple:—(1) Educational and financial control of all the most important colleges to be in the hands of the University; (2) the creation of a University quarter by concentration of as much of the University work as possible, together with its administration, on a central site [the Imperial College must remain where it is]; (3) government of the University by a small Senate, predominantly lay, and not representative of special interests; (4) control of the teaching and examination in the hands of the teachers; (5) continuance of access to University examinations by external students. The place of the Imperial College in a reconstituted University is one of the first points the Departmental Committee proposes to investigate.

SOCIETIES AND ACADEMIES.

CAMBRIDGE.

Philosophical Society, October 27.—Prof. Hobson in the chair.—R. D. **Kleeman**: The dependence of the relative ionisation in various gases by β rays on their velocity, and its bearing on the ionisation produced by γ rays.—N. P. **McCleland**: Note on a dynamical system illustrating fluorescence.

PARIS.

Academy of Sciences, October 27.—M. P. Appell in the chair.—The President announced the death of M. Lucas Championnière.—Maurice **Hamy**: An arrangement of spectrograph with an objective grating suitable for the measurement of radial velocities.—H. **Deslandres** and L. **d'Azambuja**: Laws relating to the structure of band spectra and to the deviations from their arithmetical series. A study of the second group of nitrogen bands. The formula expressing the results differs from that applicable to line spectra.—Ch. **Moureu**, P. Th. **Muller**, and J. **Varin**: Refraction and magnetic rotation of compounds containing the acetylene group. Experimental data are given for ninteen substances containing the group $-C \equiv C-$.—M. **Depéret** was elected a non-resident member.—A. **Claude** and L. **Driencourt**: A coincidence micrometer free from the personal equation. This method is based on the use of a deformable micrometer network, one set of wires being capable of moving, retaining their parallelism; the distance between the wires is equal to the path described by the image of an equatorial star in the principal focal plane during an integral number of beats of the chronometer. So soon as the star enters the field, the first wire is set to coincide with the image at a beat of the chronometer. If the adjustment is exact, the passage over the next wire will also coincide with a beat, and this can be repeatedly verified. The method of observation is capable of a very high precision.—P. **Chofardet**: Observations of the new comet 1913*e* (Zinner) made at the Observatory of Besançon.—Jean **Chazy**: Certain trajectories of the problem of *n* bodies.—MM. **Chipart** and **Liénard**: The sign of the real part of the roots of an algebraic equation.—Georges **Rémoundos**: The theorem of Picard in a circle of which the centre is a critical algebraic point.—Maurice **Janet**: The existence and determination of solutions of systems of partial differential equations.—Henri **Villat**: The validity of the solutions of the problems of hydrodynamics.—Emile **Borel**: Kinematics in the theory of relativity.—M. **Girousse**: The electrolysis of lead and iron in the soil: a discussion of the effects of stray currents from tramway systems. It is pointed out that the usual rule, a drop of potential of not more than one volt per kilometre, is insufficient. The essential point is the difference of potential between the metallic substances capable of being attacked and the tramway rails. It is shown that the amount of moisture in the soil is one of the main factors of the problem. The resistance of the contact surface is also important; the contact of lead with earth is much more resistant than the contact of iron with earth. No critical potential is required to produce electrolytic effects.—G. **Sagnac**: Luminous æther demonstrated by the effect of the wind relative to the æther in an interferometer in uniform rotation.—L. **Gay**: The pressure of expansibility of normal liquids.—M. **Taffanel**: The combustion of gaseous mixtures and gaseous velocities.—Clément **Berger**: The preparation of aluminium ethylate. Amalgamated aluminium reacts with alcohol in presence of a small quantity of sodium ethylate, and pure aluminium ethylate can be isolated from the resulting solution.—Ch. **Boulanger** and J. **Bardet**: The presence of gallium in commercial aluminium and its separation. The spectrographic examination of commercial aluminium showed strong gallium lines, and a successful attempt was made to isolate gallium from this product. 1·7 kilograms of the metal were dissolved in hydrochloric acid, treated with sulphuretted hydrogen first in hydrochloric acid and then in acetic acid solution, and the product heated with potash solution to remove iron. 0·3895 gram of gallium oxide was obtained, or 0·017 per cent. of metallic gallium on the aluminium taken. The purity of the product was proved spectroscopically.—R. **Bossuet** and L. **Hackspill**: A group of metallic phosphides derived from the hydrogen phosphide P_5H_2. Rubidium phosphide, Rb_2P_5, dissolves readily in liquid ammonia, and this reacts with a solution of lead nitrate in the same solvent, giving the corresponding lead phosphide, PbP_5. Other metals give similar phosphides, but their purification offers great difficulties.—Roger **Douris**: The addition of hydrogen to a secondary alcohol derived from furfurol in presence of nickel. A study of the reduction products of ethylfurfurylcarbinol.—P. **Lemoult**: Leucobases and colouring matters derived from diphenylethylene. The action of the ethyl and methyl magnesium iodides upon Michler's ketone.—Marcel **Mirande**: The existence of a cyanogen compound in *Papaver nudicaule*.—P. **Sisley** and Ch. **Porcher**: The elimination of artificial colouring matters by the lacteal glands. Various harmless dyestuffs (uranine, B-rhodanine, methylene blue, dimethyl-amino-azobenzene) were administered to goats and dogs, both by ingestion and injection. The colouring matters were almost completely arrested by the lacteal glands, little or no colour appearing in the milk.—Em. **Bourquelot**, H. **Hérissey**, and J. **Coirre**: The biochemical synthesis of a sugar of the hexabiose group, gentiobiose.—Sabba **Stefanescu**: The phylogeny of the crown of the molars of mastodons and elephants.

BOOKS RECEIVED.

The Ocean. By Sir John Murray. (Home University Library.) Pp. 256+xii plates. (London: Williams and Norgate.) 1*s*. net.

Higher Algebra. By Dr. W. P. Milne. Pp. xii+586. (London: E Arnold.) 7*s*. 6*d*. net.

Graphical Methods. By Prof. C. Runge. Pp. viii+148. (New York: Columbia University Press; Oxford University Press.) 6*s*. 6*d*. net.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Band iii., 37 Lief. (Jena: G. Fischer.) 5 marks.

The Use of Vegetation for Reclaiming Tidal Lands. By G. O. Case. Pp. iv+36. (London: St. Bride's Press, Ltd.) 2*s*. net.

The Divine Mystery. By A. Upward. Pp. xv+309. (Letchworth: Garden City Press, Ltd.) 10*s*. 6*d*. net.

A Shorter Algebra. By W. M. Baker and A. A. Bourne. Pp. viii+320+lix. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*.

Bell's Outdoor and Indoor Experimental Arithmetics. First Year's Course. Pp. 31. Second Year's Course. Pp. 32. Third Year's Course. Pp. 39. Fourth Year's Course. Pp. 39. Fifth Year's Course. Pp. 48. (London: G. Bell and Sons, Ltd.) 3*d*. and 4*d*., 3*d*. and 4*d*., 3*d*. and 4*d*., 4*d*. and 6*d*., and 4*d*. and 6*d*. respectively.

Bergens Museums Aarbok 1913. 1 and 2 Heft. (Bergen: J. Griegs Boktrykkeri.)

In the "Once upon a Time." By L. Gask. Pp. 283+plates. (London: G. G. Harrap and Co.) 3*s*. 6*d*. net.

Chemistry, Inorganic and Organic, with Experiments. By C. L. Bloxam. Tenth edition, rewritten and revised by A. G. Bloxam and Dr. S. J. Lewis. Pp. xii+878. (London: J. and A. Churchill.) 21*s*. net.

Die Strudelwürmer (Turbellaria). By Drs. P. Steinmann and E. Bresslau. Pp. xi+380. (Leipzig: Dr. W. Klinkhardt.) 9 marks.

Tintenfische mit besonderer Berücksichtigung von Sepia und Octopus. By Dr. W. T. Meyer. Pp. 148. (Leipzig: Dr. W. Klinkhardt.) 4 marks.

Camp Fire Yarns of the Lost Legion. By Col. G. Hamilton-Browne. Pp. xiii+301. (London: T. W. Laurie, Ltd.)

Bird Life throughout the Year. By Dr. J. H. Salter. Pp. 256. (London: Headley Bros.) 7s. 6d. net.

Elementary Theory of Alternate Current Working. By Capt. G. L. Hall. Pp. vi+195. (London: *The Electrician* Printing and Publishing Co., Ltd.) 3s. 6d. net.

Department of the Interior. Weather Bureau. Annual Report of the Director of the Weather Bureau for the Year 1910. Parts 1 and 2. Pp. 171. (Manila: Bureau of Printing.)

Memoirs of the Indian Meteorological Department. Vol. xxii., part 2. Monthly and Annual Normals of Number of Rainy Days. By Dr. G. T. Walker. Pp. 203–403. (Calcutta: Superintendent, Government Printing, India.) 1 rupee 8 annas.

Vorlesungen über Pflanzenphysiologie. By Dr. L. Jost. Dritte Auflage. Pp. xvi+760. (Jena: G. Fischer.) 16 marks.

The Moose. By A. Herbert. Pp. viii+248+8 plates. (London: A. and C. Black.) 5s. net.

Wild Life on the Wing. By M. D. Haviland. Pp. iv+244+8 plates. (London: A. and C. Black.) 5s. net.

Highways and Byways of the Zoological Gardens. By C. I. Pocock. Pp. xii+192+plates. (London. A. and C. Black.) 5s. net.

The Tutorial Algebra (Advanced Course), Based on the Algebra of Radhaknishman. By Drs. W. Briggs and G. H. Bryan. (Eighth Impression.) Fourth edition. Pp. viii+647. (London: W. B. Clive.) 6s 6d. net.

Practical Science for Engineering Students. By H. Stanley. Pp. vii+166. (London: Methuen and Co., Ltd.) 3s.

Wisconsin Geological and Natural History Survey. Bulletin No. xxvi. Educational Series, No. 3. The Geography and Industries of Wisconsin. By Prof. R. H. Whitbeck. Pp. v+94+xx plates. (Madison, Wis.)

Das kleine botanische Praktikum für Anfänger. By E. Strasburger. Siebente Auflage. By Dr. M. Koernicke. Pp. x+264. (Jena: G. Fischer.) 6.50 marks.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 6.

ROYAL SOCIETY, at 4.30.—The Soil Solution and the Mineral Constituents of the Soil: A. D. Hall, W. E. Brenchley, and L. M. Underwood.—Studies in Heredity. II. Further Experiments in Crossing British Species of Sea Urchins: Prof. E. W. MacBride.—Synthesis by Sunlight in Relationship to the Origin of Life; Synthesis of Formaldehyde from Carbon Dioxide and Water by Inorganic Colloids acting as Transformers of Light Energy: Prof. B. Moore and T. A. Webster.—The Trypanosomes causing Dourine (Mal de Coit or Beschälseuche): Dr. B. Blacklock and Dr. W. Yorke.—Postural and Non-Postural Activities of the Mid-Brain: T. G. Brown.—The Nature of the Coagulent of the Venom of *Echis carinatus*: J. O. W. Barratt.

FRIDAY, NOVEMBER 7.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Wood Waste, &c., as Fuel for Gas Producers: G. E. Lygo.

GEOLOGISTS' ASSOCIATION, at 8.—Annual Conversazione.

SATURDAY, NOVEMBER 8.

BRITISH PSYCHOLOGICAL SOCIETY, at 3.30.—A Comparative Study of Normal and Sub-normal Children by Means of Mental Tests: Dr. A. R. Abelson.—A Reaction Pendulum, and a Disc, illustrative of Weber's Law, for Use in Class Teaching: Prof. J. Brough.—Observations on the Process of Learning and Relearning in Mice and Rats: Miss M. E. Macgregor.—*A priori* Argument for the Existence of a Cerebral Centre for Affection: Dr. A. Wolgemuth.

MONDAY, NOVEMBER 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Work and Adventures of the Northern Party of Captain Scott's Antarctic Expedition: Raymond E. Priestley.

TUESDAY, NOVEMBER 11.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction of the "White Star" Dock and adjoining Quays at Southampton: F. E. Wentworth-Sheilds.

ZOOLOGICAL SOCIETY, at 8.30.—On Freshwater Decapod Crustacea (Families Potamonidæ and Palæmonidæ) collected in Madagascar by the Hon. Paul A. Methuen: Dr. W. T. Calman.—On a Collection of Reptiles and Batrachians made by Dr. H. G. F. Spurrell, in the Colombian Choco: G. A. Boulenger.—A Revision of the Cyprinodont Fishes of the Subfamily Pœciliinæ: C. Tate Regan.—Sponges in Waterworks: Prof. W. N. Parker.—Two new Actinians from the Coast of British Columbia: Prof. J. Playfair McMurrich.

MINERALOGICAL SOCIETY, at 5.30.—A Crystalline Basic Copper Phosphate from Rhodesia: A. Hutchinson and A. M. MacGregor.—(1) On the Meteoric Stone of Wittekrantz, South Africa: (2) On the Remarkable Similarity in Chemical and Mineral Composition of Chondritic Meteoric Stones: Dr. G. T. Prior.—Notes on the Minerals occurring in the neighbourhood of Meldon, near Okehampton, Devonshire: A. Russell.—On a Calcium-iron-garnet from China: J. B. Scrivenor.

THURSDAY, NOVEMBER 13.

CONCRETE INSTITUTE, at 7.30.—Presidential Address: E. P. Wells.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Pressure Rises: W. Duddell.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Preparation of Eye-preserving Glass for Spectacles: Sir William Crookes.—On an Inversion Point for Liquid Carbon Dioxide in regard to the Joule-Thomson Effect: A. W. Porter.—Negative After-Images and successive Contrasts with Pure Spectral Colours: A. W. Porter and Dr. F. W. Edridge-Green.—The Positive Ions from Hot Metals: Prof. O. W. Richardson.—(1) The Diurnal Variation of Terrestrial Magnetism.—(2) A Suggestion as to the Origin of Black Body Radiation: G. W. Walker.

FRIDAY, NOVEMBER 14

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—On the Thermal Conductivity of Mercury by the Impressed Velocity Method: H. R. Nettleton.—On Polarisation and Energy Losses in Dielectrics: Dr. A. W. Ashton.—A Lecture Experiment to illustrate Ionisation by Collision and to show Thermoluminescence: F. J. Harlow.

ALCHEMICAL SOCIETY, at 8.15 (at The International Club, Regent Street, S.W.)—The Hermetic Mystery: Mme. Isabelle de Steiger.

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*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2298, Vol. 92] THURSDAY, NOVEMBER 13, 1913 [Price Sixpence

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LECTURES, SESSION 1913-14. FIRST COURSE.

ROYAL INSTITUTION OF GREAT BRITAIN,

ALBEMARLE STREET, PICCADILLY, W.

Professor H. H. Turner, D.Sc., D.C.L., F.R.S., will deliver a Christmas Course of Six Illustrated Lectures (adapted to a Juvenile Auditory) on "A Voyage in Space." The Starting Point—Our Earth, Saturday, Dec. 27, 1913, at 3 o'clock; The Start through the Air, Tuesday, Dec. 30; Journeying by Telescope, Thursday, Jan. 1, 1914; Visit to the Moon and Planets, Saturday, Jan. 3; Our Sun, Tuesday, Jan. 6; and The Stars, Thursday, Jan. 8. Subscription (for Non-Members) to this Course, One Guinea (Juveniles under sixteen, Half-a-Guinea); to all the Courses in the Session, Two Guineas. Tickets may now be obtained at the Office of the Institution.

BEDFORD COLLEGE FOR WOMEN

(UNIVERSITY OF LONDON),

YORK GATE, REGENT'S PARK, N.W.

SECONDARY TRAINING DEPARTMENT.

Head of the Department ... Miss Sara Melhuish, M.A.

The Course, to which Students are admitted in January and October, includes full preparation for the Examinations for the Teaching Diplomas granted by the Universities of London and Cambridge.

Applications for Entrance Scholarships, Grants, &c., for the Course beginning January, 1914, should be sent to the Head of the Department not later than December 6.

BRITISH MUSEUM (NATURAL HISTORY).

APPOINTMENT—SWINEY LECTURESHIP ON GEOLOGY.

The Trustees of the British Museum will shortly appoint a LECTURER on this Foundation. The Lectureship is open to Graduates in any Faculty in the University of Edinburgh who have obtained their degrees after examination. The appointment will be for one year or more, as the Trustees may determine. The stipend is £140 a year for an annual course of twelve lectures.

Applications, accompanied by not more than three testimonials, must reach the Director, British Museum (Natural History), Cromwell Road, London, S.W., not later than January 10, 1914.

L. FLETCHER, Director.

LONDON HOSPITAL.

"LIDDLE" PRIZE.

Under the Will of the late Dr. John Liddle the College Board of the London Hospital offer a Prize of the value of £120 for the best Essay on "The Ventilation of Schools and Public Institutions."

The Prize is open to public competition.

Essays should be sent to the Dean, from whom further particulars may be obtained, on or before May 31, 1914.

Professor WILLIAM WRIGHT, M.B., D.Sc., F.R.C.S., Dean.
London Hospital Medical College,
Mile End, E.

NORTHERN COUNTIES TRAINING SCHOOL OF COOKERY AND HOUSEHOLD ECONOMY,

NORTHUMBERLAND ROAD, NEWCASTLE-UPON-TYNE.

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Preference will be given to applicants holding a University Degree or its equivalent.

Salary £130, rising by £10 annual increments to £150, with lunch and tea during term.

Applications, stating qualifications and experience, should be forwarded to the Principal before December 1.

UNIVERSITY OF BRISTOL.

DEPARTMENT OF AGRICULTURAL AND HORTICULTURAL RESEARCH.

Applications are invited for the post of PLANT PHYSIOLOGIST AND POMOLOGIST.

The initial salary will be £200 per annum.

Further particulars may be obtained from the undersigned, to whom applications, accompanied by copies of testimonials, should be sent not later than November 24, 1913.

JAMES RAFTER, M.A., Registrar.

THE UNIVERSITY OF LIVERPOOL.

The Council invite applications for the post of ASSISTANT LECTURER in PHYSIOLOGY and LECTURER in EXPERIMENTAL PSYCHOLOGY. Duties to commence with the Lent Term. Salary £250. Applications should be forwarded to the undersigned (from whom further particulars may be obtained) on or before November 30.

EDWARD CAREY, LL.B., Registrar.

UNIVERSITY OF LONDON.

THIS IS TO GIVE NOTICE that the Senate will shortly proceed to elect Examiners in the following subjects for the year 1914-15.

The Examiners appointed may be called upon to take part in the Examination of both Internal and External Students. Full particulars of the remuneration of each Examinership can be obtained on application to the Principal.

HIGHER EXAMINATIONS FOR MEDICAL DEGREES.

Examinerships.	Present Examiners.
Four in *Medicine*	Norman Dalton, M.D., F.R.C.P. Humphry Davy Rolleston, M.A., M.D., B.C., F.R.C.P. W. B. Warrington, M.D., Ch.B., F.R.C.P. Vacant.
Two in *Obstetric Medicine*	Henry Russell Andrews, M.D., B.S., M.R.C.P. Vacant.
Two in *Pathology*	Prof. Robert Muir, M.A., M.D., F.R.S. Vacant.
Four in *Surgery*	Frédéric F. Burghard, M.D., M.S., F.R.C.S. William F. Haslam, M.B., Ch.B., F.R.C.S. Henry Betham Robinson, M.D., M.S. F.R.C.S. Vacant.
Two in *Tropical Medicine*	Prof. F. M. Sandwith, M.D., F.R.C.P. Vacant.

The Examiners above named are re-eligible, and intend to offer themselves for re-election.

N.B.—Attention is drawn to the provision of Statute 124, whereby the Senate is required, if practicable, to appoint at least one Examiner who is not a Teacher of the University.

Candidates must send in their names to the Principal, with any attestation of their qualifications they may think desirable, on or before MONDAY, DECEMBER 15. (It is particularly desired by the Senate that no application of any kind be made to its individual Members.)

If testimonials are submitted, three copies at least of each should be sent. Original testimonials should not be forwarded in any case. If more than one Examinership is applied for, a separate complete application, with copies of testimonials, if any, must be forwarded in respect of each.

University of London,
South Kensington, S.W.,
November, 1913.

By Order of the Senate,
HENRY A. MIERS,
Principal.

DURBAN TECHNICAL INSTITUTE.

DURBAN, NATAL, SOUTH AFRICA.

PROPOSED SUGAR SCHOOL.

The Council of the Durban Technical Institute are considering the establishment of TWO LECTURESHIPS, one in the CHEMISTRY and one in the BACTERIOLOGY of CANE SUGAR. The work of the gentlemen appointed would be to give instruction at the Institute and to conduct investigations and research in connection with the local cane sugar industry. The appointments in the first instance will be for three years at a salary of £400 per annum in each case. The Council invite applications which should be sent to the undersigned.

B. M. NARBETH, B.Sc.,
Principal.

KENT EDUCATION COMMITTEE.

DARTFORD LOCAL HIGHER EDUCATION SUB-COMMITTEE.

COUNTY SCHOOL FOR GIRLS, DARTFORD.

Applications are invited for the following appointments for January next:—(1) A SCIENCE MISTRESS. Subjects—Botany, Physics, Chemistry and Geography. (2) A LANGUAGE MISTRESS. Subjects—Latin, French and English. Initial salary, in each case, £100 to £120 per annum, according to qualifications and experience. University Graduates desired with good Secondary School experience in teaching subjects on modern lines. Forms of application and scale of salaries may be obtained from Mr. D. F. Brow, Technical Institute, Dartford. Applications must be forwarded, as soon as possible, to Miss A. M. Brett, County School for Girls, Dartford. Canvassing will be considered a disqualification.

By order of the Committee.

Sessions House,
Maidstone,
October 30, 1913

FRAS. W. CROOK,
Secretary.

THURSDAY, NOVEMBER 13, 1913.

THE ZEEMAN EFFECT.

Researches in Magneto-Optics. With Special Reference to the Magnetic Resolution of Spectrum Lines. By Prof. P. Zeeman. (Macmillan's Science Monographs.) Pp. xvi+219 +viii plates. (London: Macmillan and Co., Ltd., 1913.) Price 6*s.* net..

THIS synthesis of our knowledge in an important and fundamental branch of physics—opened up by our author in 1896, and afterwards cultivated so zealously and fruitfully by many workers, but by himself far in front of all others—will be most welcome to all who wish to keep abreast of the advancing tide of electrical and optical discovery. Prof. Zeeman has paid us the compliment of writing his book in English; and nowhere, perhaps, will he have more attentive readers than here. Though occasional slight differences of idiom betray that the work is not composed in his native language, yet the clearness and directness of statement, and the conciseness of exposition, enable him to cover a large field, so to speak in a single view, in a manner which will make the book a permanent companion of all who are interested in the progress of the marvellous subject which is indissolubly associated with the name of the Professor of Physics of Amsterdam.

In the early days of this research it could scarcely have been anticipated that it would grow almost into a separate science. The present writer well remembers the earliest announcement in this country of the first phase of Prof. Zeeman's discovery, which was contained in a single sentence in NATURE in December, 1896, imbedded in the midst of an abstract of proceedings of the Amsterdam Academy of about a month before; its importance was, however, at once grasped, and the experiment was promptly repeated and verified by Lodge. The idea of a spectrum line being widened by a magnetic field had in fact been thought of; but a rough estimation had shown that if the ions concerned are comparable in mass to atoms, the effect would be far too slight for practical detection. The actual smallness of the inertia of the electron, only 1/1500 of that of the hydrogen atom, which made all the difference in this regard, could not have been anticipated. But when Zeeman's full paper came to hand, it was found to include much more; not only Lorentz's brilliant and decisive test of a magnetic influence, and its verification, viz., the circular polarisations of the edges of the widened spectral line: it also contained the establishment of an actual splitting of each line into sharp components, which had been suggested as possible, though one would imagine scarcely likely, by the special circumstances of Lorentz's simple illustration of a single electron revolving round a centre of force.

This latter very remarkable result, the sharp multiplication of the line instead of a mere general broadening, remains the theoretical crux of the subject, and at the same time is that feature of definiteness which makes and will make the Zeeman phenomenon so effective a probe as regards the inner physical structure of the individual molecules of matter.

The value thus found for the ratio of charge to inertia, for the negative optical electron, fell at once into line with the value belonging to the free corpuscles of J. J. Thomson—the Crookes-Stokes torrent of charged particles which carry the kathode current in vacuum tubes—as announced by the discoverer of free electrons, and of their stupendous translatory velocities, in the earlier part of the same year. Thus the electron theory, which already embraced in its theoretical scope all electric phenomena as well as all effects of radiation, was raised, by convergence from both its aspects in the same year, from a mental constructive synthesis to the rank of tangible experimental fact. Special electron theories could thus in future be launched out in detail, into regions of tentative speculation hitherto almost regarded as fanciful, as the test of experiment became applicable more and more as a check on their exuberance or an indication for their fruitful modification.

The earliest general comparative study of the phenomena of resolution, for the various spectral lines of the same chemical element and of related elements, was made in the two following years by Preston, working within the circle of FitzGerald's influence in Dublin, who was able, as it happened, to turn to account a powerful Rowland grating that had just previously been established at the Royal University. The circumstances which prevented Zeeman himself, for nearly ten years, from proceeding with the full exploration of his own subject in this direction—namely, his transfer from the Leyden laboratory to a lectureship at Amsterdam University, and the very imperfect spectroscopic equipment which he found there—are recorded here not without pathos, at the beginning of chap. iv., in explanation of his occupation during those years mainly on side problems which could be attacked with small optical powers.

The rule announced by Preston, and now appropriately known by his name, as it arose out of his last piece of work before the premature termination of a promising career in science, viz., that in each spectral series the magnetic separations measured in frequency are the same for all lines, and that there is close parallelism for elements of the same chemical group, remains the chief generalisation in this branch of the subject. It was fully confirmed by the much more extensive investigations of Runge and Paschen published three years later. But in fact the narrower foundation on which Preston built may well have appeared at the time to be sufficient, in view of the pertinent theoretical considerations.

The fundamental puzzle, why there should be definite resolution at all, instead of hazy broadening, has already been referred to. The most general theoretical system for which definite resolution can be predicted remains now, as then, one composed of any number of negative electrons describing orbits, however entangled, under their mutual repulsions in a field of force steady (or nearly steady), thus due to positive charges fixed (or nearly fixed, as they may well be, even though free, on account of attached inertia), and symmetrical with respect to the axis of the impressed magnetic field. In such a case the effect of an impressed magnetic field H on the system is the same as that of an impressed rotation round the axis of the field with velocity $\omega = eH/2m$; and in the analysis of the radiation which the system sends out, all its spectral lines are therefore divided into normal triplets, *i.e.* according to the elementary Lorentz rule, with the common interval $\omega/2\pi$ in their frequencies. If a natural spectral series had been found to behave differently from this theoretical system, it would at that time have been a matter for surprise: yet in Runge and Paschen's work, though Preston's rule is obeyed, the resolution proved often to be very different from the normal triplet type which is characteristic in the proposition above quoted. Instead, however, these experimenters found order of a more general kind, the components, often more than three, being usually symmetrically spaced at intervals which are equal to or exact sub-multiples of the standard Lorentz amount.

Not a few attempts have been made for the theoretical elucidation of this remarkable rule; but it probably still remains as a touchstone for the next substantial advance in the dynamics of molecular structure. Prof. Zeeman rather hints his opinion that its range of approximate application may be limited, just as the original standard triplet resolution proved to be exact only in special systems. Large accumulations of material exist for detailed comparative study: the subject has in fact now definitely entered the chemical laboratory, and attention is specially directed by our author to the work of J. E. Purvis with Dr. Liveing's spectroscopic equipment at Cambridge, revealing identical types of resolution in the spectra of numerous elements in which series are not as yet known.

For further progress on the physical side, much higher resolving power is a desideratum, which, indeed, is now rapidly being applied. A beginning has been made (by Nagaoka in a recent letter in NATURE, August 25) in the mapping of the remarkable changes of type of resolution of the definite satellites attached to certain lines, as the magnetic field is increased: this phenomenon, and the simplification, in fact fusion, which has been found by Paschen and Back to ensue in the resolution of close multiple lines, when the field becomes very great, and more recently by Fortrat, following early isolated observations by Michelson and others, lend weight to Voigt's hypothesis of some kind of vibrational linkage between adjacent lines, even when their own modes of resolution are of different types.

Such difficulties as these have obstructed the general theory, as approached from the side of the radiation from magnetised flames. But at an early stage Voigt had formulated the problem—and has since developed it in many directions, analytically and experimentally, with his usual mastery—from the point of view of propagation of incident radiation through a magnetised medium, a subject already discussed for transparent media in theories of Faraday's rotation of the plane of polarisation and of the related Kerr effect of reflection. If that type of theory is expressed so as to exhibit the mechanism of selective absorption, by the explicit introduction of terms appropriate to molecules vibrating by resonance and attached to the medium, and also of general damping terms when expedient, a dark narrow band which would be single in the absence of an impressed magnetic field should become resolved into Zeeman components when such a field is included; or at any rate this fact will be a guide to the form of the equations.

Almost simultaneously with this theoretical discussion, the Italian physicists Macaluso and Corbino broke the cognate experimental ground, by the detailed observation of an absorption line under very high dispersion, showing that the known excessive and anomalous refraction at its borders was accompanied by excessive and anomalous magnetic rotation, superposed on the magnetic resolution of the line. Indeed, very soon after Zeeman's first discovery, Righi had put the resolution of the line in evidence in a most effective and beautiful manner, in an absorption experiment, simply by showing that a magnetic field restored visibility of the line when applied to an absorbing vapour between nicols crossed for extinction of the light.

In the theoretical procedure of Voigt the radiating molecule has thus disappeared from the scene, or rather has become latent; the problem proposed is now to represent the effect of the medium in bulk heuristically, as well as may be, by introduction of appropriate new types of terms into the differential equations of propagation, new types which owe their justification, or at any rate their suggestion, to the general physical nature of the interaction of the molecules with the æther in the magnetic field. The aim is thus coordination of phenomena rather than their explanation; and the procedure is specially appropriate to that philosophical view which restricts the sphere of physics to the adequate formulation of the relations subsisting between the tangible experimental data. The mode in which the interaction of the vibrating molecules gives rise in a general way to such terms in the equations of propagation, including the relation of reciprocity of the Zeeman to the Faraday effect, had been exhibited by FitzGerald, by means of simple illustrative systems, about the same time. All these converging activities show how ripe for the harvest ideas had become, through the progress of the general theory of absorption and the related anomalous dispersion, first essayed by Young with imperfect means of analysis a century ago, and effectively developed in experiment and theory by Kundt, Maxwell, Rayleigh, Sellmeier, Helmholtz, &c. in more recent days.

Similarly, allusion has been made above to the circumstance that the times had been ripening, before Zeeman's discovery, towards the understanding of the relations of a magnetic field to the vibrations of the molecules which take part in the emission or transmission of radiation. The most remarkable and even precise anticipation of all, and one which by good fortune incited Prof. Zeeman to enter upon his investigation, was an experimental attempt made by Faraday himself, which our author had come to know of, very appropriately, from a reference in a lecture by Clerk Maxwell. Then there was the additional fortunate circumstance that Prof. Lorentz was at hand at Leyden, to bring to bear his exact ideas on the nascent discovery and point out the path for further developments. These are opportunities, seemingly merely born of concurrent chances, yet such as are only grasped by men worthy of them. The skill in optical experimentation, which is revealed by the investigations recorded in this treatise, connotes a long training for the tasks there undertaken: we are thus reminded of Prof. Zeeman's early exact measurements on the Kerr effect in reflection of light from a magnetic pole (not mentioned in this book), by which he won his spurs at Leyden, doubtless in that problem also enjoying the stimulus of Lorentz's advice and inspiration.

Recently the centre of interest has shifted in this subject into a purely observational side, to the mountain peak in California where G. E. Hale and his associates, by refined and determined work with the very powerful special equipment of the Carnegie Observatory, have realised in marvellous ways, still awaiting closer interpretation, one of Zeeman's anticipations in his earliest paper, the application of the method to the exploration of the magnetic phenomena of the sun, greatly expanding thereby our picture of the activities of the ultimate source of all our light and power.

But we must stop: these topics, and many others of absorbing and often perplexing interest, may be followed up in the book itself. Less than twenty years ago the Zeeman effect was unknown, we may almost say unthought of. Already it permeates, as a method of coordination and discovery, all the most refined problems of electrical and optical science. We have now a handbook of the present state of the subject, of the right degree of detail, written from the experimental point of view without undue occupation or distraction with theoretical speculations for which it yet arranges the material, with brief side expositions recalling to mind succinctly such knowledge of related subjects, spectral resolving power, spectral series, &c., as is essential to the argument: and this reasoned survey has come to us from the hands of the discoverer and chief experimental promoter of the Zeeman phenomenon.

J. L.

P.S.—In the foregoing review of Prof. Zeeman's monograph, which was written early in October, it is remarked that recent observations, especially by Paschen and Back, and afterwards by Fortrat, on the modification of the Zeeman effect in strong fields, give support to the theory advanced by Voigt, which postulates mutual influence between the constituents of a close multiple line in the spectrum. The case may now (November 4) be put stronger. The recent account by Fortrat of the magnetic resolution of a sodium doublet (*Comptes rendus*, October 20, 1913, p. 635) seems to leave no room for doubt that the equations advanced by Prof. Voigt are of the essence of the matter.—J. L.

MALARIA AND PARASITOLOGY.

(1) *Malaria, Cause and Control.* By Prof. W. B. Herms. Pp. xi+163. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 6*s*. 6*d*. net.

(2) *A Laboratory Guide to the Study of Parasitology.* By Prof. W. B. Herms. Pp. xv+72. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 3*s*. 6*d*. net.

(1) THE volume on malaria is written in a popular style, and is intended to educate the intelligent public as well as the expert on the methods of controlling this disease. It contains much valuable information, and should be read by all those who live in malarious districts. The contents of the book are based mainly on the author's four years' experience in the State of California. This State is noted for its healthful climate, yet in many localities malaria is a scourge. Malaria is the principal cause of absences from the rural public schools in the infested districts, and three-fourths of the malaria in California is found in nine out of twenty-four malarial counties. The Board of Health there estimates that the annual loss from this disease amounts to 2,820,400 dollars.

A short and popular account is given of the various stages of development of the malarial germ, in the human body and in the mosquito, in order that the reader may obtain a more intelligent grasp of the methods of prevention. The germ is transmitted by the bite of certain species of anopheline mosquitoes. A lucid and well-illustrated description is given of the anopheles and other mosquitoes in general in order to teach the reader how to detect easily the dangerous varieties which transmit the disease.

The breeding places, development, and habits of these insects are thoroughly described. This information is necessary, since the methods of controlling and eradicating the disease are based upon this scientific knowledge. Prevention consists mainly in a systematic and determined crusade against mosquitoes. These can be best attacked at their source of production, or, in other words, their breeding grounds must be destroyed or rendered unsuitable for their development. This is done by draining or filling in the swampy lands near habitations and by spraying oil or poisons on stagnant pools of water. It is also important to destroy as much as possible by fumigation the adult mosquitoes in dwellings; these should be screened in order to prevent the mosquitoes from gaining an entrance. Probably the most important part, however, of an anti-malarial campaign is the systematic education of the public, so that their intelligent co-operation may be obtained. A considerable portion of the book deals with this important subject. Among other methods, the public is best educated by the aid of the local Press and by popular lectures. The book is excellently illustrated throughout, and nothing has been omitted in the endeavour to make the subject clear and intelligible to the ordinary reader.

(2) The work on parasitology is intended to give students a wide practical view of the subject in its application to the health and well-being of man and beast. It is arranged so as to provide sufficient matter for a full laboratory session on human and veterinary parasitology. It is divided into exercises, each of which is sufficient to occupy the student in the laboratory for two and a-half to three hours. The various orders of disease transmitting insects are dealt with, including bed-bugs, mosquitoes, gnats, horse flies, house flies, stable flies, bot flies, lice, ticks, and mites. Parasiticides and their method of use are given. Amœbæ, trypanosomes, and malarial parasites have each one exercise devoted to them. Under the heading of helminthology come the round worms, hook worms, lung worms, whip worms, trichina, filariæ, leeches, flukes, tape worms, &c. A special exercise is devoted to helminth ova and another to the various anthelminthics. Finally, exercises are given on the life-histories of the common house fly, the mosquito, and the flea.

This book must necessarily be of great value to the student and to the teacher. There are no illustrations, but it is intended for use in the laboratory with a lecturer and material at hand, and also as a practical supplement to a general course of lectures on the subject.

A POPULAR MINERALOGY.

The Mineral Kingdom. By Dr. Reinhard Brauns. Translated, with additions, by L. J. Spencer, Parts 1–25. Pp. 432+91 plates. Esslingen-a-N.: J. F. Schreiber; London: Williams and Norgate, 1912.) Price 2*l*. 10*s*. net.

IN the preface to the original German edition Prof. Brauns states that the book was written for the admirers and collectors of minerals, and aimed at increasing the number of those interested in such things. Since its appeal is to the layman rather than to the student or the expert, the arrangement of the book is somewhat different from that usual in text-books on the subject. A general part deals briefly—perhaps too briefly for satisfactory exposition—with the characters of minerals—their crystalline form, physical properties, and chemical composition. In the other, and principal, part the characters, chief occurrences, and uses of the principal mineral species are very fully described.

Since the reader for whom the book is intended is mainly interested in knowing what each mineral is used for, the species are grouped together, not as is customary in modern text-books according to their crystallo-chemical relations, but to the uses to which they are put, an arrangement which has much to commend it in a popular work. Thus in the first section we find the ores and the minerals resulting from their weathering, meteorites forming an appendix to iron; in the second the precious stones; in the third the rock-forming minerals, a group of extreme importance, though individually not often attaining to very prominent size; in the third the mineral salts, which includes, besides rock-salt, the phosphates, and the minerals supplying the rare earths, &c., several species left over, such as the calcite and barytes groups; and lastly we have the organic compounds. Some useful hints on the collection and preservation of specimens are given in an appendix. A valuable feature of the book consists in the extensive series of coloured plates, on which are depicted as faithfully as the chromo-lithographic process will permit some of the finest specimens contained in the principal German collections.

The English translation was entrusted to the efficient hands of Mr. L. J. Spencer, of the Natural History Museum, and Prof. Brauns was fortunate in securing the services of one so well qualified for the task. While adhering to the general design of the original, Mr. Spencer has made many small additions and alterations which render the book of greater value to English readers. Since the German edition appeared nearly ten years ago, he has introduced more recent statistics than were given in the original. Owing to a change of publishers the English edition, which, like the German, was issued in parts, was considerably delayed, and was not finally published until last year. For that reason some of the information—for instance, that regarding the carat-weight—is already out of date.

OUR BOOKSHELF.

The Golden Bough: a Study in Magic and Religion. Third edition. Part vi., The Scapegoat. By Prof. J. G. Frazer. Pp. xiv + 453. (London: Macmillan and Co., Ltd., 1913.) Price 10*s.* net.

THE sixth part of "The Golden Bough" deals with the folklore and priest-craft of that characteristic human failing, the avoidance of responsibility. The extraordinary prevalence and similarity of the popular ideas and practices in the matter of sin-transference, expulsion of evils, expiatory sacrifices, and vicarious atonement, as shown by Prof. Frazer in a myriad cases from China to Peru, is enough to make the social and political philosopher despair of humanity. The story of "The Scapegoat" depicts the negative aspect of representation, which is the dark and lurid side of social morality. In his famous description of the periodic rage of the people against social offenders Macaulay simply illustrates the modern form of the savage "expulsion of evils." The idea culminates in the use of the Dying God as a scapegoat to free his worshippers from the troubles with which life is beset. The author concludes that "the idea resolves itself into a simple confusion between the material and the immaterial, between the real possibility of transferring a physical load to other shoulders, and the supposed possibility of transferring our bodily and mental ailments to another who will bear them for us." What was in the previous edition the spectacular climax of the exposition, viz., the brilliant explanation of the Gospel story of the Crucifixion as embodying the ritual of the mock king and popular (not to say royal) substitute in sin, is relegated to an appendix, as being doubtful. This is possibly a mistake. Prof. Frazer goes out of his way to assert his belief in the historicity of Jesus. The occasion demanded an examination of the facts.

An important addition is a careful study of the Aztec religion of human sacrifice, the secret lever of which has not yet been discerned. It should be compared with the *auto-da-fé* of Christianity. Such comparisons are avoided by Prof. Frazer, who will not go down to the ultimate depths. Another new feature is an extended treatment of the use of games as magical processes to change the weather, and so forth. Hence the author too easily assumes that certain games were originally magical rites, which is absurd.

But the book is a storehouse of social facts, sympathetically treated, and invaluable to those interested in the development of society and the moral law. As an analysis of religious ideas, of course, like the other volumes, it is epoch-making.

A. E. CRAWLEY.

Reports from the Laboratory of the Royal College of Physicians, Edinburgh. Edited by Dr. G. L. Gulland and Dr. James Ritchie. Vol. xii. (Edinburgh: Oliver and Boyd, 1913.)

THIS volume of Reports contains contributions of workers in the laboratory of the Royal College of Physicians, Edinburgh, during the year 1912, and is edited by the Curator, Dr. Gulland, and the Superintendent, Professor Ritchie. Anatomy, pharmacology, pathology, and bacteriology are the branches of medical science represented, and the papers are valuable contributions to science and are evidence of the useful work which is being done in this laboratory.

Of the papers of more general interest, we note Dr. Gardner's on soaps and their effects on the skin. He concludes that all soaps are more or less irritant to the normal skin, particularly the cheaper soaps made with cotton-seed and other oils and rancid fats. Soaps, even when combined with antiseptic substances, possess little or no antiseptic power, even in more than the quantities in which they are ordinarily used. Dr. Addis has investigated the causation of hæmophilia, the "bleeding disease." He finds that the essential factor is a qualitative defect in the prothrombin, whereby blood coagulation in the hæmophilic individual is delayed; on the other hand, quantitatively all the elements necessary for blood-coagulation are present in the normal individual.

Distemper in dogs and other animals has been investigated by Dr. M'Gowan, who has regularly isolated in this condition a bacterium with distinct characters. Dr. John Fraser has investigated the prevalence of the human and bovine types of the tubercle bacillus in bone and joint tuberculosis occurring in children. He finds that the bovine type of bacillus is present in more than half the cases.

The Edinburgh College of Physicians is to be congratulated on the results of their liberal endowment of research; and in the preface due acknowledgment is made of additional financial assistance received from the Carnegie Trust. R. T. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Piltdown Skull and Brain Cast.

In my previous letters (NATURE, October 2, p. 131, and October 30, p. 267) I refrained from entering into a detailed consideration of the reconstruction of the Piltdown skull, because I am preparing for presentation to one of the learned societies a full statement of all the facts and considerations bearing upon the points at issue. But I am glad to accede to Prof. Keith's invitation (NATURE, November 6, p. 292) to publish a drawing of the brain cast for comparison with his (NATURE, October 16, p. 198, Fig. 2).

It is a pleasure to express my hearty agreement with his appreciation of the excellence of Mr. Barlow's workmanship and of Dr. Smith Woodward's courtesy in permitting anatomists freely to handle and examine the precious fragments. Mr. Barlow's casts of the fossil bones are certainly the best examples of such modelling that I have ever seen; and I strongly resent the interpretation (*op. cit.*, p. 292) put upon my remarks in reference to them. But even such realistically perfect copies cannot display structural details such as the texture of bone, the precise location of certain faintly marked sutures, and the nature of sutural edges of the bones; and all of these points are of crucial importance in this discussion.

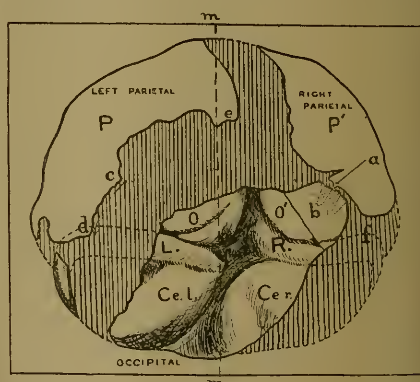
On the actual fragments, for example, one can see quite plainly a part of the *right* half of the coronal suture (not visible on the cast), meeting the more obvious left half at an angle which must, of course, be upon (or very close to) the median plane. Now this point lies upon the forward extension of the plane *mm* (see fig.), which was determined from other evidence (see NATURE, October 30, p. 267).

Then again the texture of the bone covering the area on the brain cast near the line *mm* just above the point *e* (see fig.) is characteristic of that which comes into contact with the median longitudinal sinus. This is further confirmation of the accuracy of the determination of the line *mm*. There are three other features of the bone in the neighbourhood of the line corresponding to *mm*, namely the supralambdoid flattening, the arrangements and medial relations of the meningeal grooves, and the median groove in the frontal region, which confirm this identification of the line *mm* as a close approximation to the real median plane.

On these grounds the orientation of the left parietal (P) to the median plane (*mm*) is settled; but we have still to determine its position in relation to the occipital upon that plane.

In spite of the extreme asymmetry of the posterior poles of the cerebral hemispheres (O and O[1]), the two halves of the cerebellum (Ce.l. and Ce.r.) and the lateral sinuses (L. and R.), the orientation of the occipital fragment upon the median plane is fixed, as Prof. Keith has explained (NATURE, October 16, p. 198).

The broken piece (*b*) fits accurately upon the main



fragment (O[1]), and as it bears upon its external face and lateral edge traces of the right part of the lambdoid suture, it is important as giving some indication of the breadth of the occipital bone at this level. [To avoid the addition of another diagram, I have inserted alongside the letter *b* a stippled design to suggest, in a purely diagrammatic manner, the extent and complexity of a small fragment of the lambdoid suture preserved upon the external face of the bone that covered the area *b*.]

Now that the occipital and left parietal fragments have been orientated upon the line *mm*, the problem remains of determining their relative heights the one to the other upon that line.

The left lateral sinus left its imprint upon the occipital (L.) and also upon the lower corner of the left parietal (at *d*). Although the sinus is sometimes distinctly arched upward as it passes from the occipital to the parietal, the points *d* and the upper margin of L are as a rule on approximately the same horizontal plane, both in man and the anthropoid apes. Thus we cannot go far wrong if we bring the occipital and the left parietal into the positions shown in the diagram.

But Prof. Keith will object (NATURE, October 16,

p. 198) that this will not bring the two halves of the lambdoid suture (*cd* and *ab*) into symmetrical positions. In answer to this criticism it may be said that the lambdoid suture in this restoration is as nearly symmetrical as it is in many ancient and modern skulls. Moreover, in the case under consideration there is the most positive evidence of a lack of complete symmetry. Not only is there the most striking asymmetry in the whole occipital area (compare O and O¹ and Ce.l. and Ce.r.), but the remains of the lambdoid suture itself present a marked contrast on the two sides, being quite simple on the left (*cd*), but complex and dentate on the right (*b*). To base any far-reaching conclusions upon the position and direction of an isolated centimetre (*b*) of the lambdoid suture (see NATURE, October 16, p 198) is simply courting disaster. For every anatomist knows that the lambdoid is the most variable and tortuous of all the cranial sutures.

Another indication of asymmetry of the lambdoid suture is the direction of the fragment marked *e*. My critics may say that as it points towards the piece *cd* and not towards *b* and *f*, it clearly belongs to the left and not to the right half of the suture, and that it would fall into its proper position if the left parietal were moved wholly to the left side of the line *mm*. But such a deviation as *e* is quite common. A precisely similar thing occurs in the Gibraltar skull, and in the La Quina skull there is a Wormian bone near the corresponding spot on the right side.

So far I have said nothing of the right parietal fragment (P¹). It bears only a very small fragment (*a*) of the lambdoid suture, which, of course, must lie somewhere near the line joining *e* and *f*. Its lower margin does not quite reach the lateral sinus at *f*. With these and other guides (supplied by the impressions of the brain and meningeal vessels) this fragment may be orientated in a position approximately symmetrical to the left side. Incidentally, as the point *a* must be in the neighbourhood of the sutural line on *b*, the position of the right parietal fragment (P¹) so determined checks the accuracy of the position of the left parietal (P).

No exact symmetry between P and P¹ is attainable because the brain itself is not symmetrical. In the human brain the type of occipital asymmetry seen in this case (O and O¹) is usually associated with a greater prominence of the right parietal eminence (P¹). This was the case in the Piltdown brain. In further confirmation of the reality of this it is found that the right parietal bone is very much thinner than the left, so that, as in the occipital region, the full extent of the cerebral lack of symmetry is not displayed in the outline of the skull.

In making the drawing illustrating this letter I have used a cranial cast which Dr. Smith Woodward kindly sent me a few weeks ago, but have made some slight alterations in the positions of the two parietal fragments.

In conclusion I should like to say how much I am indebted to Prof. Keith for all the help he has given me in my investigations, not only by allowing me to make use of all the valuable material in the museum of the Royal College of Surgeons, but also by discussing with me frankly and openly all the points in dispute concerning the Piltdown skull itself. In the earlier part of July, working with the cranial casts, he seemed to me to have established a good case for his mode of reconstruction; but from the moment I began to examine the actual fragments (August 13, 1913, the day after the discussion of the matter at the International Medical Congress) I became convinced that his solution of the problem was an impossible one. It was this personal experience of the importance of working with the real things that I had in mind when I was writing my last letter (NATURE, October 30, p. 267). G. ELLIOT SMITH.

The University of Manchester.

The Piltdown Mandible.

IN *The British Journal of Dental Science* of October 1, there are published some excellent radiograms of the Piltdown mandible and of a chimpanzee's, the views having been taken from the side and from above.

In order to compare the outlines of the two specimens, I have superimposed tracings taken from each (Figs. 1 and 2).

FIG. 1.—Outline tracing from radiograms of the Piltdown mandible (continuous line) and of the mandible of chimpanzee (broken line).

The similarity of the specimens brought out in this way is very striking, for the outlines are practically identical. I have also superimposed tracings of the last reconstruction of the Piltdown mandible and of the jaw of a young chimpanzee (Fig. 3), and again the similarity of the outline is very remarkable. No human mandible is known which shows anything

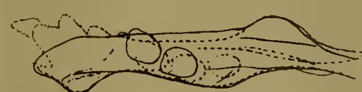


FIG. 2.—Outline tracing from radiograms of the Piltdown mandible (continuous line) and of a chimpanzee (broken line as viewed from above.

like the same resemblance to the chimpanzee jaw in outline and in all its details.

Of the molar teeth, I need only say here that not only do they approach the ape form, but in several respects are identical with them.

The cranial fragments of the Piltdown skull, on the other hand, are in practically all their details

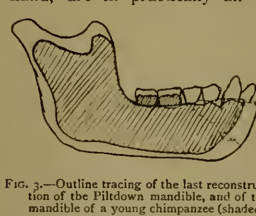


FIG. 3.—Outline tracing of the last reconstruction of the Piltdown mandible, and of the mandible of a young chimpanzee (shaded

essentially human. If that be so it seems to me to be as inconsequent to refer the mandible and the cranium to the same individual as it would be to articulate a chimpanzee foot with the bones of an essentially human thigh and leg. DAVID WATERSTON.

University of London, King's College,
Strand, W.C.

Darwinism 100 Years Ago.

WHO was the first to propound clearly the idea of sexual selection as an important factor in evolution? "Darwin, of course," is the usual answer, even of those who, sneering at this great man, delight in pointing out that it was not he who first promulgated the improving effects of selection, and that all he himself did introduce was the subsection of sexual selection; according to them a baseless idea.

Recently I happened to come across the following statement by Friedrich Tiedemann, in his "Anatomie und Naturgeschichte der Vögel" (Zweiter Band, p. 13, Heidelberg, 1814):—"Very often there arise fights between the males for the possession of the females. . . . These fights, which take place also between very many mammals, seem to be very important for the conservation of a healthy progeny, since only the strongest and most vigorous males propagate the race, whilst the young and too old individuals, being weak, are conquered, and removed from the act of propagation.

Tiedemann, who flourished just one hundred years ago, was a zoologist with great and clearly expressed ideas, and the following quotations may be of interest to some readers of NATURE:—

"'Metamorphosis of the Birds.' There is a metamorphosis concerning the whole life of the indivdual bird, from the moment of hatching to its death. There is further a yearly metamorphosis, culminating with the period of propagation; and a less significant diurnal change. Lastly, *there is a metamorphosis due to successive geological epochs*" (pp. 288–325).

". . . With every larger geological epoch (Erd-Revolution) some animals have perished. . . . But it seems also that after each of such revolutions new animals have been formed, mainly—I suppose—through gradual metamorphosis and alteration of the previous remaining animals into new kinds (Thierformen), caused by new climatic and physical influences" (p. 322).

". . . These fossil rests of birds testify to the age of the class of birds. But since all these remnants seem to belong to extinct kinds of birds, they can be taken as proofs that in the course of time the species is just as much subject to metamorphosis as the individual" (p. 325).

H. GADOW.

Cambridge, October 23.

The Stone Implements of the Tasmanians.

THE stone implements of the Tasmanian aborigines are frequently cited as an instance of the survival of an Eolithic assemblage into modern times. Having collected eoliths on the Kent plateau and similar chipped pieces of stone in South Africa, and having recently had the opportunity of collecting worked stones on an old camping ground of the Tasmanian aborigines, I feel impelled to make a few comments on this assertion.

The site that I visited, under the guidance of its discoverer, Mr. W. S. Smith, of Launceston, is about two miles east of that town. It is about ten acres in extent, and occupies rising ground at the side of a stream—a characteristic position, I am told. It is now sparsely strewn with flakes, among which trimmed examples are rare; formerly the reverse was the case, Mr. Smith having removed about 400 trimmed flakes. The ground was ploughed several years ago, so that a large number must be buried. Several such sites are known around Launceston, and Mr. Smith has a large collection from them. I have also examined the collection of the Rev. C. S. Wilkinson and those under the charge of Mr. H. H. Scott, of the museum. Both of these are from various parts of Tasmania, but present the same general facies as those from the neighbourhood of Launceston.

If we accept the eoliths of the Kent plateau as typical, then these Tasmanian implements are certainly not true eoliths, for instead of being made from naturally broken pieces of stone, they are made from artificially produced flakes. They are not even comparable to the flake-eoliths of South Africa, for they include examples that exhibit a neatness of edge-trimming and resultant regularity of outline that is never met with among them. At the same time the bulk of the Tasmanian implements are characterised by an unskilful trimming and irregular outline that remind one forcibly of the eoliths, while they frequently exhibit characteristic eolithic shapes. The minority remind me strongly of a prominent element in some of those South African assemblages that approach nearest to the Aurignacian.

If we eliminate the more advanced implements from these pseudo-Aurignacian assemblages, then they resemble the Tasmanian assemblage, with this difference, that in the one the Eolithic resemblances are subordinate, and in the other they are predominant.

In attempting to convey an idea of the lowly status of the Tasmanian implements by the use of European terminology, one is therefore not justified in speaking of them as Eolithic. Pre-Aurignacian would more correctly indicate their position.

J. P. JOHNSON.

Launceston, Tas., September 25.

A Further Parasite of the Large Larch Saw-fly.

MAY I be permitted to add a brief note to the letter written by Mr. Mangan, which appeared in NATURE of July 24 (vol. xci., p. 530)? In the account of the examination of the parasites that have emerged this year from cocoons collected in the Thirlmere district, it was stated that 25 per cent. of the cocoons yielded specimens of an undetermined species of Mesoleius.

Since the letter was written, this new parasite has been identified by Prof. Otto Schmiedeknecht as *Hyperablys albopictus* grav. (syn. *Mesoleius trans fuga,* Holmgr.). It is described by Mr. Morley in "Ichneumonologia Britannica," vol iv., under the name *Euryproctus albopictus* grav. It has apparently never been hitherto recorded from *Nematus erichsonii*; it has been bred, however, by Brischke (*Schr. Nat. Ges.*, Danz., 1871) from larvæ of *N. hypogastricus* and of *N. testaceus* in Prussia, and has also been bred, probably at Worcester, from *Camponiscus luridiventris.*

This species is readily distinguished from *Mesoleius tenthredinis* by the white colour of the first and the second coxæ and the dark tint of the third. The face in the female is marked with white, and in the male the white marking present in both species is broader than in *M. tenthredinis.*

R. A. WARDLE.

Department of Economic Zoology,
Victoria University of Manchester.
November 3.

LICENCES FOR WIRELESS TELEGRAPHY.

A QUESTION of considerable importance is raised in certain correspondence which has passed between Mr. F. Hope-Jones and the Secretary to the Post Office in relation to the conditions under which the postal authorities are prepared alone to issue licences, at the present time, for the installation of apparatus for the reception of wireless time signals. Since the commencement of the present year the postal authorities have commenced to charge a fee of *1l. 1s.* in connection with the issue of ordinary licences for a wireless installation; a protest has been raised in some quarters to this charge, and the legality of the action of the authorities has been doubted. However, as the postal authorities have explained that the fee is charged to recoup the expenses incurred in connection with the registration of licences, no serious objection can, it is thought, be raised on a question of principle to this charge, although at first sight it seems difficult to justify so large a fee as *1l. 1s.*, in respect of what is, to a great extent, merely routine clerical work.

The correspondence to which reference has been made raises, however, quite another question. The inauguration of the International Time Service on July 1 last has placed at the disposal of watch and clock makers, as well as the members of the public generally, a means of ascertaining correct time, which involves only a relatively small outlay on a simple wireless receiving set of apparatus. Before such apparatus may be installed for use it is, of course, necessary to obtain a licence from the Postmaster-General. Quite recently applications have been submitted for the necessary licence for such purposes, and in reply thereto the postal authorities have notified the applicants that the introduction of an annual royalty charge of *2l. 2s.* is in contemplation in respect of such installations, and, in consequence, (briefly speaking) licences can alone be issued, provided that applicants make a deposit of *3l. 3s.* (or *2l. 2s.* if the fee of *1l. 1s.* already referred to has been paid) pending the settlement of the question.

No indication is given in the correspondence under review of the source from which the postal authorities claim to derive the power to levy the said annual royalty. As is well known, the powers of control in respect of wireless telegraphy vested in the Postmaster-General are derived wholly from the Wireless Telegraphy Act of 1904; and, therefore, since the postal authorities are at the present time laying down a condition precedent to the grant of a licence, it seems fair to presume that the provisions of the Act of 1904 referred to are relied upon in justification of the demands now being made. It is not surprising in the circumstances that considerable resentment should have been aroused in relation to what can only be considered as an extremely arbitrary attitude on the part of the postal authorities in this matter.

It is evident that the question raised by Mr. F. Hope-Jones has a two-fold importance. In the first place, it raises a question of constitutional usage, and in the second place that of the conditions under which the development of our industries generally is to be permitted to take place under bureaucratic rule. From the constitutional aspect, the real point at issue seems to be whether it is competent for a Government Department to exercise a power of imposing taxes on the public generally, or an industry in particular, without express parliamentary authority. In the time of the Tudors and the Stuarts, the Crown did certainly attempt to exercise a power of independent legislation, in virtue of asserted prerogative by licence and dispensation, or by proclamation and ordinance. The fruit of such action was to give birth to collisions in the courts of law, with the ultimate result that, after violent struggles, the principle was clearly established that the Crown may not legislate or impose, save with the consent of Parliament; and so far as we are aware this principle remains in force at the present day.

The provisions of the Wireless Telegraphy Act of 1904 appear to leave no doubt, on the face of it, as to the intentions of the legislature in framing this measure; and it is evident that no power was, in express terms, conferred on the Postmaster-General, or his advisers, to impose anything in the nature of a tax or other annual charge. If the postal authorities, therefore, persist in their present attitude, it will become necessary to test the legality of their action before the established tribunals of the country.

On investigating the actual merits of the case, quite apart from the constitutional aspects of the situation, we feel that the attitude of the postal authorities in this matter is one requiring condemnation as being entirely opposed to the wise and generous principles which have guided public policy in matters affecting monopolies from very early times right up to the present day. The fact that the monopoly in telegraphs is vested in the State does not appear to afford a good reason for departing from the great principle that it is the duty of a Government to stimulate new industries and not to injure them. It was the recognition of the importance of this principle which in Tudor times established for us the commercial supremacy we have been enjoying for many centuries past. The fact that the postal authorities themselves have not established any system of wireless time signals of which the public may avail themselves, either openly or surreptitiously, seems in itself to afford sufficient grounds for the argument that no justification exists for the contemplated royalty charge in respect of wireless time signal installations. But another serious reason for offering resistance to the proposal lies in the possibility that Government Departments may easily extend the application of the principle on which the postal authorities appear to be acting, to the great prejudice of the public interest, if it is submitted to without protest at the present time. We are strongly of the opinion that the postal authorities are acting contrary to justice and common right, and that they are attempting to impose an unprofitable charge, calculated to do wrong to the liberty and trade of the subject. We hope, therefore, that strenuous opposition will be offered to the imposition of the proposed tax by all who are concerned with either the scientific or applied aspects of wireless telegraphy.

DR. ALFRED RUSSEL WALLACE, O.M., F.R.S.

THE death of Alfred Russel Wallace on November 7, at ninety years of age, marks a milestone in the history of biology. For he was the last distinguished representative of a type that can never be again—a combination of naturalist-traveller, biologist, and geographer, a knower of species, and yet from first to last a generaliser "inquisitive about causes," and, with all this, an investigator who stood outside any of the usual methods of analysis, with "a positive distaste for all forms of anatomical and physiological experiment." It will probably be a very long time before a biologist again rises to real distinction apart from experimental analysis in some form or other. His career and scientific work were described in these columns by Prof. H. F. Osborn in June of last year (vol. lxxxix., p. 367), and we hope to publish a further appreciation of him next week. Here, therefore, we do little more than record his death and point to some outstanding characteristics of his life.

In thinking of Wallace's contributions to science, we recall first the feverish week at Ternate, when he wrote his famous letter to Darwin, "like a thunderbolt from a cloudless sky," expounding the idea of natural selection—a letter which was communicated, along with extracts from Darwin's unpublished work, to the Linnean Society at the historical meeting on July 1, 1858. Everyone is proud of the magnanimity with which each discoverer treated the claims of the other. Their detachment from everything but getting at the truth was congruent with the nobility of both. It was indeed just what might have been expected, but there was throughout an instinctive generosity which has always appealed to the ethical imagination. Darwin's helpful friendliness was met by Wallace's devoted loyalty, which was conspicuous, for instance, when he gave his fine book of 1889 the title "Darwinism," or emphasised at the 1908 celebration the fact that the idea of natural selection had occurred to Darwin nearly twenty years before the joint paper of 1858. Well was it said of him, "Darwinii æmulum, immo Darwinium alterum."

After natural selection, one thinks of the geographical distribution of animals, and it may be justly said that this study, which has evolved vigorously in many directions in the last generation, got its modern start from Wallace's standard work (1876), which fulfilled its intention of bearing to the eleventh and twelfth chapters of the "Origin of Species," a relation similar to that which "Animals and Plants under Domestication" bears to the first. It was followed up by the more popular "Island Life," which has been a stimulus to many a travelling naturalist, and has prompted numerous investigations.

The building up of a science often reminds one of the waves making a new beach—multitudes of particular movements which are not in themselves permanent, but make others of more lasting effect possible. Perhaps the same should be said of much that Wallace's fertile mind contributed, for instance, in regard to sexual selection, concerning which he was wisely sceptical, in regard to "warning colours" and "recognition marks," in regard to the part played by instruction and imitation in the development of instinctive behaviour; and many more instances might be given. As an old man he was impatient of the recent work which centres round Mendelism and mutations, but it was a fine example of his earlier plasticity of mind that he entirely agreed with Weismann in finding the transmission of acquired characters unproved. His independence was conspicuously shown by the vigour with which he maintained in his "Darwinism" and elsewhere that the facts of man's higher nature compel us to postulate a special "spiritual influx," comparable to that which intervened, he thought, when living organisms first appeared and when consciousness began. He may have lacked philosophical discipline, but he was never awanting in the courage of his convictions. Throughout his life he was given to puzzling over difficult problems far beyond the range of biology—in economics and astronomy, in psychology and politics, and perhaps it was this width of interest in part that kept him young so long.

There was a great humanity about Alfred Russel Wallace, which won affection as surely as his services to science commanded respect. Like many hard workers he found time to be generously kind to young men; he did not suffer fools gladly, but he was always ready to champion the cause of the oppressed; he could never divest himself of his citizenship, and almost to his last breath he was thinking of how things might be made better in the State. By nature quiet, gentle, reflective, and religious, he had no ambitions save for truth and justice and the welfare of his fellow-men; he was satisfied with plain living and high thinking, with his garden, and with that "double vision" which was always with him. For, whatever we may think of his "spiritualism," it was peculiarly his—

> To see the world in a grain of sand,
>   And heaven in a flower;
> To grasp infinity in the palm of the hand
>   And eternity in an hour.

SIR WILLIAM HENRY PREECE, K.C.B., F.R.S.

WILLIAM HENRY PREECE was born near Carnarvon on February 15, 1834, being the eldest son of R. M. Preece. He died at Penrhos, Carnarvon, on November 6, 1913, being in his eightieth year. All his professional life had been connected with telegraphic engineering and the development of electrical engineering; and, saving for the veteran, Mr. C. E. Spagnoletti, who survives him, he was the oldest telegraph engineer in Great Britain. After completing his education at King's College, London, he entered the office of the late Mr. Edwin Clark, who was connected with pioneering work of submarine cables, and at the age of nineteen he was appointed as a junior engineer on the staff of the Electric and International Telegraph Company, becoming later superintendent of the company's southern division. From 1858 to 1862 he acted as engineer to the Channel Islands Telegraphs, and in 1860 was appointed telegraph engineer to the London and South-Western Railway, and made Southampton his headquarters. In 1864 he married Miss Agnes Pocock, of Southampton, who died in 1874. After ten years of railway telegraph work, he became a divisional engineer under the Post Office, which was then creating a telegraphic staff to deal with the many undertakings which it was taking over from the companies under the Telegraph Act of 1870. From that time his promotion was steady. He was appointed Electrician to the General Post Office in 1877, and Engineer-in-Chief, an office of much more importance then than now, in 1892. In 1894 he was made C.B.; and he was given the honour of K.C.B. on his retirement under the age rule in 1899. Since that date until his decease he was senior partner in the firm of Preece, Cardew, and Snell, consulting engineers; though his failing health for several years past precluded him from much active participation in the responsible work of his firm.

Sir William Preece was an indefatigable worker, and one who was constantly before the public eye by reason of the lectures which he gave, the papers which he contributed to the scientific and professional bodies on telegraphic and electrical inventions, and the considerable part he played in the internal working of the professional societies. He was one of the earliest members of the Society of Telegraph Engineers (now the Institution of Electrical Engineers), to the proceedings of which he made numerous contributions. Its earliest volume (1871–2) contains a lecture which he gave to Postal Telegraph Engineers on the advantages of scientific education, and reports a discourse on the rise and progress of telegraphy, which he gave at the Albert Hall on June 18, 1872. During the next dozen years his contributions to the meetings and journal of the Society of Telegraph Engineers were numerous, and ranged from such topics as shunts, and the winding of electromagnets, to the then newly invented phonograph of Edison. He was President of the Society in 1880, and again in 1893, after its reconstitution as the Institution of Electrical Engineers, to which body he contributed later several papers on telegraphy and electric lighting.

Sir William Preece took a great interest in the early development of the telephone, and gave papers on it to the Physical Society and the Society of Arts, and to the British Association during several successive years. In 1888 he was President of the Mechanical Engineering Section of the British Association at Bath. He read several papers also before the Royal Society in connection with telephone and photophone; also on the effects of temperature on the electromotive forces and resistances of batteries; on a standard of light; and on studies in acoustics; the last-named in conjunction with Mr. Stroh. He was elected a Fellow of the Royal Society in 1881, and served on the Council of that body from 1887 to 1889. He made several communications of importance to the Institution of Civil Engineers on submarine cables, and on various points in the use of electricity on railways, including intercommunication between passengers, guards, and drivers of trains in motion. He delivered the "James Forrest" lecture on the relations between electricity and engineering, and in 1889 became President of the Institution. To the Society of Arts he gave a number of papers and lectures on electric lighting, and on electrical exhibitions, and delivered a set of Cantor lectures in 1879. He was chosen Chairman of the Council of the Society of Arts for the year 1901–2. He took out patents in his earlier career for various inventions in connection with duplex telegraphy and railway signalling. As a lecturer he excelled, having a good delivery and a power of presenting matters in a simple and practical way. His lecture in 1878 on electric lighting at the Albert Hall, during the height of the electric lighting fever, will not be readily forgotten by his hearers; while his discourses at the Royal Institution, where he expounded various recent developments in electric lighting, telephony, and telegraphy, were always welcomed by a crowded audience.

Sir William Preece will probably be best remembered in after time by the pioneering work he carried out for a number of years on the subject of telegraphy without wires, experimenting as he did by conductive and inductive methods across arms of the sea, such as the Bristol Channel or the Solent, or from land to lighthouse, or between coal mines. To this work he had been attracted by observations of the stray currents which, on the establishment of telephonic circuits in London in 1884, were found to disturb even well-insulated lines. In 1892 he was able to send inductive messages across the Bristol Channel between Penarth and the Flat Holm, a distance of more than three miles. In 1895 he established temporary wireless communication between the Island of Mull and Oban, during an interruption of the cable connecting them, before a cable-repairing ship could arrive. Strange to say, he entirely missed the significance of the wireless signalling by Hertzian waves that was shown by Oliver Lodge at the British Association meeing at Oxford in 1894; and yet when Signor Marconi arrived upon the scene in 1896, using the same method and the same devices of oscillators, spark-gaps, coherers, and tappers, Sir William Preece received him with open arms, and put the resources of the Post Office at his disposal, with results known to all the world.

Sir William Preece wrote several valuable textbooks—one on telegraphy in conjunction with Sir James Sivewright, and two on the telephone.

Sir William's work at the Post Office during the strenuous years of the development of the national telegraphic system out of the conflicting systems of rival companies, is a record of honest work conscientiously performed. As Chief Engineer he enjoyed the confidence of successive Postmasters-General, and his attainments and qualifications raised the prestige of that post. It is a deplorable circumstance that since he quitted it, the post of Chief Engineer has been degraded and circumscribed, so that now the occupant of what should be a post of dignity and independent technical responsibility can only approach the Postmaster-General through secretaries or other non-technical officials, and is not even master over the technical men in the Post Office Department. This could never have occurred in the days when Sir William Preece was Chief Engineer; his efforts to secure adequate recognition for the scientific and technical side of telegraphic work were persistent and successful during the term of his administration. That he had the courage of his opinions all who knew him intimately are well aware; yet even in his severest contentions with opponents he bore no malice. A foreign "inventor" who had trifled with him he indignantly showed to the door; a deserving subordinate who had some technical improvement to suggest found in him a sympathetic listener. Doubtless he had the defects of his qualities. His entire inability to appreciate the work of Oliver Heaviside is inexplicable in view of the stress he laid at times upon the need for technical men to study abstract theory. Genial, cheery, thorough, industrious to the last degree, Sir William Preece's name and memory will long be cherished. An excellent portrait of him by Miss Beatrice Bright adorns the walls of the Institution of Civil Engineers. He held the distinction of Officier in the Légion d'Honneur, and was a Doctor of Science of the University of Wales.

S. P. T.

NOTES.

THE President of the Board of Education has appointed Dr. Aubrey Strahan, F.R.S., to be Director of the Geological Survey and Museum, in succession to Dr. J. J. H. Teall, F.R.S., who will retire from the post on January 5 next.

MR. AUSTEN CHAMBERLAIN has received from the Secretary of State for India a contribution of 500*l.* towards the fund for the enlargement and endowment of the London School of Tropical Medicine. The fund now amounts to 71,276*l.*

AT the annual meeting of the Challenger Society, held on October 29, Sir John Murray, K.C.B., in the chair, the following officers were elected for the ensuing year:—*Secretary,* Dr. W. T Calman; *Treasurer,* Mr. E. T. Browne; *Committee,* Prof. E. W. MacBride, Messrs. D. J. Matthews and C. Tate Regan.

AT Dijon on November 9 the centenary was celebrated of the discovery of the element iodine by the French chemist, Bernard Courtois, who was a native of Dijon. Prof. Camille Matignon, professor of mineral chemistry at the Collège de France, gave an address on the history of iodine and its identification as an element. A commemorative tablet is to be placed on the house, 78 rue Monge, Dijon, where Courtois was born.

IT is announced that the Swedish Academy of Sciences has decided to award this year's Nobel prize for physics to Prof. Kamerlingh Onnes, of Leyden, and the prize for chemistry to Prof. A. Werner, of Zurich. Each prize is worth about 788o*l.*

THE next annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 7 and 8, 1914. By the kind invitation of the Comité des Forges de France, the autumn meeting next year will be held in Paris, on Friday and Saturday, September 18 and 19. The first half of the following week will be devoted to excursions to the chief iron mining and manufacturing districts of France. The Bessemer gold medal for 1914 will be awarded to Dr. Edward Riley.

THE death is announced on November 10, at fifty-seven years of age, of Dr. R. D. Sweeting, Senior Medical Inspector of the Local Government Board. Dr. Sweeting was for twenty years hon. treasurer of the Epidemiological Society of London, afterwards becoming fellow of the Royal Society of Medicine and vice-president of the Epidemiological Section. In 1890 he joined the Medical Department of the Local Government Board, of which he had served as temporary inspector during the Cholera Survey of 1885-6.

ON the recommendation of the committee on the award of the Hodgkins prize of 300*l.* for the best treatise on the relation of atmospheric air to tuberculosis, which was offered by the Smithsonian Institution in connection with the International Congress on Tuberculosis, held in Washington in 1908, the institution announces that the prize has been equally divided between Dr. Guy Hinsdale, of Hot Springs, Virginia, for his paper on tuberculosis in relation to atmospheric air, and Dr. S. Adolphus Knopf, of New York City, for his treatise on the relation of atmospheric air to tuberculosis.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council at the anniversary meeting on December 1:—*President:* Sir William Crookes, O.M. *Treasurer:* Sir Alfred Kempe. *Secretaries:* Sir John Bradford, K.C.M.G., and Prof. A. Schuster. *Foreign Secretary:* Dr. D. H. Scott. *Other Members of the Council:* The Right Hon. A. J. Balfour, Prof. W. M. Bayliss, Dr. F. W. Dyson, Dr. H. J. H. Fenton, Prof. W. Gowland, Dr. F. G. Hopkins, Sir Joseph Larmor, Prof. C. H. Lees, Prof. E. W. MacBride, Prof. G. Elliot Smith, Prof. J. Lorrain Smith, Sir John Thornycroft, Prof. W. W. Watts, Mr. A. N. Whitehead, Mr. C. T. R. Wilson, and Dr. A. Smith Woodward.

A TABLET to the memory of Capt. L. E. G. Oates, of the 6th (Inniskilling) Dragoons, who lost his life in the Scott Antarctic Expedition, has been erected by his brother officers in the Parish Church of Gestingthorpe, Essex, where his family reside, and was unveiled on November 8. The tablet bears the following inscription:—"In memory of a very gallant gentleman, Lawrence Edward Grace Oates, Captain in the Inniskilling Dragoons. Born March 17, 1880. Died March 17, 1912. On the return journey from the South Pole of the Scott Antarctic Expedition, when all were beset by hardship, he, being gravely injured, went out into the blizzard to die, in the hope that by so doing he might enable his comrades to reach safety. This tablet is placed here in affectionate remembrance by his brother officers. A.D. 1913."

THE death is announced, at the age of seventy-seven, of Dr. J. P. Kimball, of Cody, Wyoming. After pursuing scientific studies in America and Germany, he was appointed geologist on the Wisconsin and Illinois State Surveys. He was occupying the chair of chemistry and economic geology in the New York Agricultural College when the Civil War broke out. He took part in that conflict as captain and assistant adjutant-general, and at the end of the war was breveted major for "gallant and meritorious services" in the Wilderness campaign. He then engaged in mining practice for several years. From 1874 to 1885 he was honorary professor of geology at Lehigh University, and from 1885 to 1888 he was director of the Mint at Washington. His later years were spent in the west, where he did considerable pioneer work upon the glaciers and mining fields, and contributed largely to American and foreign technical journals.

IT is announced that the Postmaster-General has appointed a committee to consider how far and by what methods the State should make provision for research work in the science of wireless telegraphy, and whether any organisation which may be established should include problems connected with ordinary telegraphy and telephony. The names of the members of the committee are as follows:—The Right Hon. C. E. H. Hobhouse, M.P. (chairman), the Right Hon. Lord Parker of Waddington, Sir Joseph Larmor, M.P., F.R.S., Sir Henry Norman, M.P., Dr. R. T. Glazebrook, F.R.S., Mr. W. Duddell, F.R.S., Mr. R. Wilkins, C.B., Rear-Admiral E. F. B. Charlton, R.N., Sir Alexander King, K.C.B., Mr. W. Slingo, Commander F. Loring, R.N., Major the Hon. H. C. Guest, M.P., and Commander J. K. Im Thurn, R.N.

THE Royal Society of Arts will commence its 160th session on November 19 with an address by the chairman of the council, Col. Sir Thomas H. Holdich. Before Christmas there will be four meetings, besides the opening meeting. The first of these will be devoted to a paper by Dr. Chalmers Mitchell, on zoological gardens; the second to a paper by Mr. John Umney, on perfumery. At the third, Mr. Thorne Baker will read a paper on applications of electricity to agriculture, and at the last meeting before Christmas, the question of the Channel Tunnel will be brought forward by Mr. Arthur Fell, M.P. There will be five courses of Cantor lectures. The first, by Prof. Coker, on the measurement of strains in materials and structure, will comprise, amongst other matters, the results of his own investigations into the application of polarised light to the measurement of stresses. The second course will be by Sir Charles Waldstein, who will deal generally with the subject of industrial art; the third by Mr. Joseph Pennell on artistic lithography. The subject of the fourth course will be announced later. The last will be by Mr. William Burton on recent developments in the ceramic industry. A course of juvenile lectures to be delivered as usual during the Christmas holidays will be given by Mr. Howgrave Graham, and will deal in a popular way with the subject of wireless telegraphy.

AT the meeting of the Royal Geographical Society the medals awarded by the society and by the Italian Geographical Society to officers and men who took part in Capt. Scott's Antarctic Expedition of 1910–13 and to relations of those who lost their lives in the expedition were presented. The Italian Ambassador presented to Lady Scott the gold Humbert medal which bore the inscription:—"Alla memoria di Robert F. Scott, R.N, Giunto Secundo al Polo Australe Suggella Colla Morte La Verità della Scoperta, 1913." The replicas in silver bore an inscription in Italian to the memory of Capt. Scott's "companions in glory and martyrdom," and were presented to Mrs. Wilson, Mrs. Oates, and Mrs. Bowers. The widow of Petty Officer Evans was not present, and the medal is to be sent to her. Lord Curzon, president of the society, presented the society's special Antarctic medal to the ladies and to Commander Pennell, R.N., Commander Bruce, R.N.R., Staff-Paymaster Drake, R.N., Lieut. Renwick, R.N., Surgeon L. Atkinson, R.N., Surgeon Levick, and to the following members of the scientific staff:—Mr. Griffith Taylor, Mr. Frank Debenham, Mr. Charles Wright, Mr. Raymond Priestley, and Mr. Apsley Cherry-Garrard. Commander V. Campbell was not present, and the medal is to be sent to him. The medal has on the obverse the inscription:—"British Antarctic Expedition, 1910–13. Captain R. F. Scott, C.V.O., R.N., Commander," and on the reverse:—"Presented by the Royal Geographical Society for the Antarctic Discovery, 1913."

AN interesting paper was read at the Royal Geographical Society on Monday, November 10, by Mr. Raymond Priestley, on the experiences of the northern party during Capt. Scott's last Antarctic Expedition. This party had been organised under the command of Lieut. Campbell in order to explore King Edward's Land, which it was unfortunately unable to reach owing to the heavy pack-ice. It accordingly adopted the alternative mission entrusted to it by Capt. Scott, and landed at Cape Adare. It thus became the northern party. As its supply of mutton was condemned immediately after landing at Cape Adare, the party was compelled to rely for meat on seals and penguins—an experience which possibly saved them the following winter. The hope of a long sledge journey to the west was frustrated by the bad condition of the sea ice, and the party therefore undertook a detailed survey of Robertson Bay. In January, 1912, the *Terra Nova* returned from New Zealand and transferred the party to the neighbourhood of the Drygalski glacier, and there the six members were landed with only stores for the summer. This district Mr. Priestley regards as of especial interest, but the paper was confined to an account of the adventures and life of the party during the following winter. Owing to the failure of the steamer to return they had to live through the winter on an island which they have named Inexpressible Island; they excavated chambers in the snow, and their food consisted of a scanty supply of seals and penguins. The experiences of this party were unique in the Antarctic, and the fact that, in spite of their sparse supply of food, they were able to live through the winter without the loss of a single man reflects the highest credit on their ingenuity and judgment. As was expected years ago, this coast is subject to strong westerly winds, which added greatly to the discomfort of the explorers. In the spring of 1913 the party sledged down the coast, found one of Taylor's food depôts, and crossed McMurdo Sound to the headquarters. Mr. Priestley regards the risks run by this party during both seasons as unduly great. He remarks of one experience, "this is the sort of thing that does not happen twice without disaster."

News was received at the latter part of last week announcing the death, on November 4, at Leyden, at the age of sixty-nine, of Dr. Fredericus Anna Jentink, director of the Rijks Museum van Natuurlijke Historie, commonly known as the Leyden Museum. Dr. Jentink's connection with the museum of which he eventually became the head was a long one, dating, we believe, at least from the 'seventies. Throughout his scientific life the deceased naturalist devoted such time as could be spared from his other duties to systematic work on mammals, one of his earlier important efforts in this direction being the catalogue of mammalian osteology in the Leyden Museum, published in 1889, which was followed by a catalogue of the entire collection of mammals, issued three years later. African mammals early attracted much of his attention; and his name is perpetuated in connection with one of the two largest species of duikerboks, or crested antelopes (*Cephalophus jentinki*). The Dutch possessions in the Malay Archipelago and Papua were, however, the means of affording to Jentink exceptional and unrivalled material for extending our knowledge of the mammalian fauna of those regions, this being especially the case in regard to the Papuan islands, from which a large number of new generic and specific types were described by him. As a climax to this work, particular value attaches to the summary of the whole mammalian fauna of Papua given by Jentink in his "Nova Guinea," if for no other reason than as showing the enormous advances which have been made in our knowledge of this subject since the appearance of Dr. Wallace's "Geographical Distribution." But his administrative and other official duties, in addition to the large amount of work he accomplished on mammals, by no means sufficed to exhaust the energies of Dr. Jentink, for after the issue of the first volumes, which commenced in 1879, he undertook the editorship of "Notes from the Leyden Museum," a task which he continued, we believe, to the end. The amount of valuable information with regard to the zoology of the Eastern Archipelago contained in the long series of volumes bearing that title is known to every worker.

The October number of *Science Progress* contains an editorial article in which the necessity for a "serious stocktaking in the business affairs of science" is emphasised, and united effort is advocated to "insist that proper attention be paid to science, that disabilities be removed, and that enough means be provided." In a striking phrase it is pointed out that "science has now become an industry. It has indeed become the premier industry of all," and the great necessity is to see that this industry is properly organised. "Men of science are apt to think that their duties extend to no more than investigation," but they must also attend to the means by which great investigation is to-day rendered possible; "the scientific education of the individual and the national encouragement of scientific work." The political importance for scientific research is emphasised: "it gives hegemony to the nations which possess it and leaves nations, like individuals, which do not possess it in a backwater of failure and poverty."

In the September issue of *The Journal of Economic Biology*, Prof. F. V. Theobald completes his revision of the British species of Macrosiphum, the genus of Aphidæ usually known as Siphonophora, and including some familiar "greenfly" pests of rose, pea, and other cultivated plants. The distinctive structural characters of each species are clearly figured, and the paper cannot but be useful to students of this important and interesting group.

The recently issued vol. ix. of the *Fortschritte der naturwissenschaftlichen Forschung* contains an interesting summary by Dr. C. Wesenberg-Lund of our knowledge of the dwellings, in the form of burrows or built-up "houses," constructed by fresh-water insects. Noteworthy are his own recent observations of the tunnelling habits of larvæ of Libelluline and other European dragonflies, paralleled by the researches of B. J. Tillyard on the Australian *Petalura gigantea*. There are also illustrated notes on the form and arrangement of tubes made by larval Chironomus, Orthocladius, Tanytarsus, and other midges. As might be expected, the greater part of the review is devoted to the architecture of the caddis-worms (Trichoptera) among which the detailed account, with drawings, of the nets constructed by Hydropsychid larvæ for catching their minute aquatic prey will be found especially interesting.

Mr. H. F. Witherby, editor of *British Birds*, informs us that the readers of that magazine have now placed more than 32,000 rings on wild birds of many kinds. This work is leading to results of great interest and importance in connection with the study of birds, and a remarkable case of a swallow ringed in Ayrshire being recovered in Orange River Colony is described in the November number. Mr. Witherby has received a letter from Mr. A. C. Theron, dated from "Riet Vallei, District Lindley, O.F.S.," stating that a swallow bearing a ring with his name and address was captured at Riet Vallei on March 16,

1913. This ring was placed on a nestling swallow by Mr. R. O. Blyth, at Skelmorlie, Ayrshire, on July 27, 1912. A few months ago an adult swallow ringed in Staffordshire was recorded as having been captured near Utrecht, Natal, in December, and the present record is from about one hundred and fifty miles west of that place, which is not far in comparison with the total length of the journey. Mr. Witherby adds:—"In writing of the Natal record I expressed surprise that a swallow breeding in the far west of Europe should migrate so far east in South Africa, but now that Dr. Hartert has shown by his observations in the middle of the Sahara that deserts are not necessarily a bar to the passage of migrating birds, as was formerly supposed, it may perhaps be presumed that these swallows take a more direct line than one would previously have thought possible."

THE monthly meteorological chart of the North Atlantic for November (first issue), published by the Meteorological Office, contains daily maps showing the distribution of air-pressure, wind, &c., for October 10–16. These exhibit at the beginning of that period low-pressure systems extending from beyond the Great Lakes' region of North America to Central Asia. The central area of the most important of these disturbances lay near latitude 53° N., longitude 27° W. It was in the heavy gales associated therewith that the ill-fated steamship *Volturno* was abandoned on October 10, near latitude 48° N., longitude 34° W. (see NATURE, October 16). The Meteorological Office report states that the effects of the storm were felt in a modified degree on the western coasts of the British Islands, the wind reaching gale-force at a few exposed points.

SOME interesting observations that promise to throw a much-needed light upon several problems in the later geological history of Northumberland and Durham were described at the opening meeting of the Northumberland Coast Club by Mr. S. Rennie Hazelhurst. Mr. Hazelhurst has found in natural and artificial exposures at the mouth of the Tyne a series 25 ft. thick of gravels, sands, clays, and loams containing well-preserved plant remains. They are traceable over an area of about a square mile, and reach an altitude of 100 ft. above the sea. The suggestion is made that they mark the site of a post-glacial lake which is regarded as exceeding in magnitude any similar lake recognised by its deposits in any other part of these islands—a claim that can scarcely be maintained in view of Fox Strangways's description of Lake Pickering. The details so far published of Mr. Hazelhurst's observations make no mention of their bearing upon the question of the alleged raised-beaches on this coast. The local geologists are unanimous in asserting the existence of a well-preserved raised beach in Northumberland and Durham at about 150 ft. above sea-level, but most outsiders regard the features as of glacial origin. A lake at 100 ft. O.D. at the mouth of the present Tyne may have preceded, or succeeded, the period of supposed submersion, and in either case the relations of the two conditions may furnish decisive arguments for or against the hypothesis of the beaches.

IN "Mendelism and the Problem of Mental Defect" (London, Dulau and Co., Ltd., 1913) Dr. David Heron enters into a lengthy and elaborate criticism of some of the work of the American Eugenics Record Office. In particular the theory that feeble-mindedness is caused by the absence of a mendelian factor, and therefore behaves when inherited as a simple recessive character is shown to be unfounded. The care and thoroughness with which Dr. Heron has performed the task of writing sixty-two pages of destructive criticism are worthy of high praise; but if, as he anticipates, "jealousy of the work of another laboratory" is assigned by some as his motive for doing something so unusual, he will only have himself to thank. For the whole pamphlet is written in a highly provocative way, and seems, intended, so far as possible, to wound the feelings of the head of the Eugenics Record Office, who is responsible in one way or another for most of the work criticised.

IN the August number of *Le Radium*, M. de Broglie gives the results of his observations of the interference patterns produced on photographic plates by Röntgen rays reflected from the surfaces of crystals. He finds that the positions of the spots obtained by reflection from various crystals of the cubic system are identical, but that the intensities are characteristic of each crystal. The effect of temperatures from that of liquid air to a red heat is slight, a diminution being just perceptible at the highest temperature. Magnetic fields of strengths up to 10,000 appear to have no effect on the patterns. M. de Broglie directs attention to the close similarity between the patterns produced by reflection of Röntgen rays from the surfaces of crystals and the patterns produced by transmitting light through two crossed diffraction gratings. As a general rule each spot shows a number of bands which the author attributes to the presence in the crystal close to the surface of incidence of regions in which the orientation of the crystalline elements varies slightly.

WE have received from Messrs. Watson and Sons, Ltd., specimens of a new optical glass, called "Spectros." Specialists have long desired a glass which would absorb (or cut out) the harmful or irritant ultra-violet rays, but which would at the same time allow the ordinary visual rays to pass unhindered. Hitherto the only lenses employed for this purpose have been made of the dark smoked or coloured glass so often seen; but unfortunately this glass not only absorbs the visual rays to a large extent but also fails to cut out the ultra-violet rays. "Spectros" glass, as it absorbs the ultra-violet and part of the red, is of a green colour, and is made in six distinct tints. The first is so light as to be practically unnoticeable—this is used for reading glasses—especially by artificial light. The other tints are used as occasion may require, and the deepest only in severe cases of ophthalmia, snow-blindness, &c. Few people recognise the harm done to eyes by the ultra-violet light present in bright electric illumination, especially by arc lamps, and on snow surfaces at a great elevation when the absorption of the atmosphere is reduced. Snow-blindness and its concomitants are due to this cause. Examined by a prism it is seen that by this "Spectros" glass all the ultra-violet light is stopped, while that in the central portion of the spectrum is allowed to pass; there are no absorption bands. Microscopists may find the use of various thicknesses or prisms of this glass an advantage in their work.

Prof. A. M. Worthington has contributed a very valuable paper on multiple vision with a single eye to vol. vi. of the Proceedings of the Royal Society of Medicine. The cause of monocular diplopia and polyopia has hitherto been considered rather obscure by ophthalmologists, who have usually contented themselves with the view of Donders that "the polyopia arises from the fact that each of the more or less regular sectors of which the eye is structurally built up forms a separate image." This explanation fails to cover the fact that even widely separated images of an object seen out of focus are at once accurately superposed, when the error is corrected by means of a suitable lens (spherocylindrical if necessary. The main value of the paper is the production of direct experimental evidence that similar multiple images are formed on a photographic plate when the lens of the camera is obscured by a spattering of black plasticine. This is a confirmation of Ruete's explanation in 1853 that polyopia was due to irregularities and opacities on the surface of the lens. Prof. Worthington has succeeded in obtaining a well-marked polyopia, or rather a multiude of images, by putting a thin layer of a dilute solution of canada balsam on a clean lantern slide. This is a very fair representation of the normal irregularities on the anterior capsule of the lens of the eye, and it will be found that, if the object be fine enough and sufficiently brightly illuminated any eye when a little out of focus will exhibit this phenomenon, which indeed may be considered as a variation of Scheiner's experiment when an object is viewed through a card pierced by a great number of pinholes. The illustrations which accompany the paper are excellent.

The address of Mr. A. G. Lyster, president of the Institution of Civil Engineers, was delivered on November 4. Mr. Lyster dealt with the constitution of port authorities as affecting the organisation and development of ports, a subject to which he brought his long experience derived in the port of Liverpool. Such authorities should be bodies capable not only of bringing special commercial knowledge and sound judgment to bear on problems with which they have to deal, but also able to take a broad view of their responsibilities and to recognise that national and imperial, as well as local interests, are involved in the successful administration of their charge. The ownership and management of docks and harbours may be grouped as (a) private, (b) public dock companies, (c) railway companies, (d) municipal corporations, (e) trusts or commissions, (f) governments. The constitution of these variously governed ports has not been based on any common standard of suitability; the adoption of a variety of systems has the merit of arriving by experience at a practical determination of their relative utility. Mr. Lyster pronounces adversely on municipal control; some of our largest ports, such as Liverpool, Glasgow, and Dublin, were under municipal control in their early stages, and it was deemed expedient to convert them into trusts, or, in the case of London, to sell the City's interest to dock companies. It is difficult to see how the essentials required of a body to manage successfully a port can be obtained under Government control. The responsible authorities in this case are remote in every sense of the word from those whose interests are involved. Under an efficient system there ought to be close connection between the management and the whole commercial interests of the port. The trust system has recommended itself to the people of this country as best suited to their largest and most important ports.

We have received the October number of "Lewis's Quarterly List of New Books and New Editions added to the Technical and Scientific Circulating Library." It contains the books which have been published and added to the library during the months of July, August, and September. The first part of the list is occupied with the additions to the medical side of the library, while in the second, under the general heading "Scientific," will be found those on such subjects as chemistry, engineering, metallurgy, motor-cars, technology, &c. Short notes are given to the more important works, and the list should be useful to students and others wishing to see what has appeared during the months included on any subject in which they are interested.

The 1914 issue is now available of the "Nature Calendar," published by Messrs. G. Philip and Son, Ltd., at the price of sixpence net. The special notes for the months of 1914 deal with problems of nature-study suitable for continuous observation. The calendar is eminently adapted for exhibition on the walls of schoolrooms and natural history club-rooms, where nature-study is taken up in a practical manner.

OUR ASTRONOMICAL COLUMN.

Comet 1913*d* (Westphal).—This very interesting periodic comet of 1852 IV. is likely, according to *The Observatory* for November, to be visible for several months, and that journal publishes an ephemeris up to the middle of January, in continuation of that given by Prof. Kobold. This ephemeris is computed with slightly different elements, and a portion of it is as follows:—

Greenwich, Midnight.

		R.A.		Dec. N.
		h. m. s.		° ′
Nov. 17	...	20 31 51	...	34 8
21	...	32 28	...	36 20
25	...	33 54	...	38 25
29	...	20 35 56	...	40 27

The comet is about magnitude 8·7, and is situated in the constellation of Cygnus.

Europium in Stellar Spectra.—In this column for October 2 reference was made to the striking variations in the spectrum of α Canum Venaticorum discovered by Prof. Belopolsky. The full account of his observations was published in the *Bulletin de l'Académie Impériale des Sciences de St. Petersbourg* (April 24, 1913). In the current number of *The Observatory* (November) Mr. F. J. M. Stratton gives an account of the work of Belopolsky on this star, and Mr. F. E. Baxandall contributes a communication on the chemical origin of certain of the spectrum lines. Some of the conspicuous lines in the spectrum of this star which underwent periodic changes were those at λλ4130·04 and 4205·20, lines of unknown origin. Mr. Baxandall has now identified these lines as two very strong lines of Europium, and the evidence is the more convincing as the other lines of Europium in the region of the spectrum photographed by Belopolsky are found also to be represented. Two other strong lines of Europium are just outside the photographed region of the star, and, as Mr. Baxandall points out, it would be of very great interest to know whether these lines are represented also. The presence of Europium lines in stellar spectra has previously been suggested by Mr. Lunt in the case of Arcturus, and Dr. Dyson and Mr. Jewell have identified them also with weak lines in the spectrum of the chromosphere.

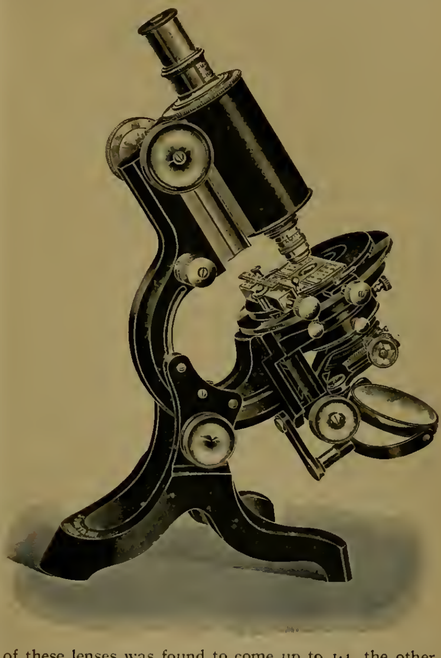
RADIAL VELOCITIES WITH THE OBJECTIVE PRISM.—The problem of obtaining radial velocities by means of the objective prism is one that needs urgent solution, and few practical workers have as yet taken the subject up. Dr. Frank Schlesinger sums up in a very interesting way the state of the problem to-day (Proc. Amer. Phil. Soc., vol. lii., No. 209, April, 1913), and stellar spectroscopists will no doubt be glad to have their attention directed to this paper. He reviews three methods of procedure, all of which, he says, warrant a trial, but he thinks that the process involving an absorptive medium to produce one or more narrow and sharp absorption bands, such as neodymium chloride, would probably lead to immediate results provided a moderate degree of precision is only wanted. Dr. Schlesinger's remarks apply chiefly to the spectra of stars fainter than the fifth magnitude, for the brighter stars are well dealt with by means of slit spectroscopes, instruments which only utilise a very small percentage of the light which falls on the slit plate.

SOLAR ACTIVITY AND CYCLONES.—In addition to the detailed observations of the meteorological elements for the year 1912, No. 2 of the Annals of the Observatory of Montserrat, Cuba, contains a study of the synchronism between solar activity and the hurricanes of the Antilles, by the director, Father Simón Sarasola, S.J. It appears that each of the last four sun-spot minima was followed by minima of cyclonic activity. Further, it is stated that maxima of cyclonic and solar activities do not coincide, although cyclones are frequent and violent about the time of a maximum of sun-spots. The dates given show a minimum of cyclonic activity in the year 1884, thus almost coinciding with a spot maximum.

MICROSCOPE STANDS AND OBJECTIVES.

WE have received from Messrs. Swift and Son their catalogue of microscopes and accessories. The microscope stands listed are of varying degrees of complexity suited to the requirements and pockets of all classes of microscopists. The higher priced stands all have centring substage condensers, and are fitted with the "improved climax" fine adjustment. This is constructed with an accurately cut micrometer screw with graduated drum fixed horizontally parallel to the coarse adjustment, and with milled heads on either side of the pillar. The adjustment automatically ceases to act should the objective touch the cover-glass. The "Premier," first constructed to the specification of Mr. J. E. Barnard, for the bacteriological department of King's College, London, is one of the most perfect stands we have seen (see figure). It is swung on an arc on the "Wales" principle; the body-tube is of wide diameter, adapted for use with wide-angled photographic lenses, and is provided with two graduated draw-tubes, one of which is actuated by a rack and pinion. The substage has centring screws, and the iris diaphragm can be racked eccentrically and rotated, so as to allow of the use of light of any azimuth, and can be swung out of the optic axis independently of the condenser.

A full series of apochromatic objectives, of which Messrs. Swift are the sole British makers, is also listed, and we have had the opportunity of examining two of the 1/12 in. oil immersions with numerical aperture of 1·4. Tested with a Zeiss apertometer, one



of these lenses was found to come up to 1·4, the other was slightly less—1·37. With both lenses the image was free from colour, and the definition excellent, even with the higher-power compensating oculars, and both lenses compare very favourably in all respects with similar lenses of other makers at double the price. We think it would be an advantage if the tube-length were engraved on the mounts of these lenses.

CHEMISTRY AT THE BRITISH ASSOCIATION.

THE chemical section was well supported throughout the meeting both by chemists and by the general public. The programme was a varied one, appealing both to the specialist and to the public generally. In particular, the discussion on fuel was of extreme importance, and it was evident that though there is far too much apathy on this question among men of science and the general public, yet a great deal is being done on scientific lines to effect greater efficiency in the utilisation of fuel. Probably nothing but economic pressure will make the public at large abandon the present wasteful methods which were indicted by Prof. Armstrong. A minor feature of the meeting was the number of chemical papers read in other sections: this is an inevitable consequence of the splitting up of the sections of the association during the last decade. The spread of chemistry is satisfactory, if it be regarded as a sign of the growing appreciation of the subject by biologists and others; but, on the other hand, it leads to statements being made and accepted without comment which would be criticised drastically by an audience of chemists.

The section welcomed Prof. Feist (Kiel), Prof. Sörensen (Copenhagen), and Prof. Tschugaeff (St. Petersburg) at its meetings, and had the pleasure of entertaining them to dinner on the Saturday evening.

After Prof. W. P. Wynne had delivered the presidential address on substitution, Mr. P. K. Dutt gave a brief account of work carried out with Prof. J. B. Cohen on the progressive bromination of toluene in which the orienting effect of the various mono- and di-halogen compounds has been studied; the results were contrasted with those obtained by chlorination.

Dr. R. S. Morrell described his recent work on the saturated acids of linseed oil which he has identified as stearic acid and palmitic acid with a trace of oleic acid. The great difficulty experienced in the quantitative separation of the fatty acids was emphasised. In a discussion of the paper, attention was directed to the necessity from the biological point of view of a more complete study of the fatty acids.

Dr. Tinkler made a communication on a series of mixtures of nitro compounds and amines which are coloured only in the liquid state, which he illustrated experimentally. Mixtures of diphenylamine with certain nitro compounds give solutions which are coloured at one temperature but become colourless on cooling. Thus a mixture of diphenylamine and parachloronitro-benzene acquires a reddish-yellow colour when held in the hand, and loses this colour when the temperature falls. The colour is considered due to the combination of nitro-compound and amine in the liquid state only. Various physico-chemical investigations of the fused mixtures were undertaken.

Mr. E. Vanstone dealt with the influence of chemical constitution on the thermal properties of binary mixtures of benzoin with other organic compounds which had been studied by the usual methods of thermal analysis.

A short paper by Mr. H. Ehrhardt established the fact that anthranilic acid is formed by the decomposition or over-reduction of indigo in the bisulphite-zinc-lime vat. Some remarks on the influence of the presence of gas upon the inflammability of coal-dust in air by Prof. W. M. Thornton completed the day's programme.

Optical Properties.

The morning of Friday, September 12th, was devoted to a series of papers dealing with the significance of optical properties. The first, by Dr. R. H. Pickard and Mr. J. Kenyon, concerned the optical rotatory powers and dispersions of the members of some homologous series of organic compounds. More than one hundred optically active compounds belonging to ten such series have been synthesised. Although they possess simple and closely related constitutions, no numerical relationship between their rotatory powers has yet been detected. Well-marked regularities are shown which are more or less common to all the series. A comprehensive account of the present state of the knowledge of optical activity was given by Dr. Pickard.

Rotatory dispersion was the subject of Dr. Lowry's paper. Formerly measurements of optical rotation were made with the light of one wave-length only, but it is necessary to make them over a range of wave-lengths, especially in the case of substances which exhibit anomalous rotatory dispersion. The methods of measuring rotatory dispersion have been greatly simplified by Dr. Lowry, so that they present no difficulty. Use is made of the green and violet mercury lines, of sodium and lithium, and also of the red and green cadmium lines. The curve of rotatory dispersion for organic liquids was shown to have an extremely simple form. It is expressed by the equation

$$\alpha = \frac{K}{\lambda^2 - \lambda_0^2}$$

where K is the rotation constant and λ_0^2 the dispersion constant for the substance. If α is plotted against λ_0^2, the curve is a simple rectangular hyperbola. If $1/\alpha$ is plotted against λ^2, the curve becomes a straight line.

Prof. L. Tschugaeff followed with a paper on anomalous rotatory dispersion, of which there are three different types. These were dealt with by the reader at some length. The shape of the dispersion curve is largely influenced by constitutive factors, the whole curve resulting from the superposition of several partial curves. The relative positions of the centres of activity and of the chromophor groups within the active molecule are of much influence. The influence of varying factors on the rotatory dispersion of the optically active xanthates was compared with that of the tartrates. There is an intimate analogy in the origin of the anomaly in both cases.

Prof. P. F. Frankland directed attention to another part of the subject, namely, the so-called Walden inversion. He gave an account of researches carried out with W. E. Garner to determine the nature of the action of thionyl chloride on lactic acid and ethyl lactate. In each case the action was very complicated, but the investigation is throwing light on the process of substitution in optically active compounds.

Dr. T. S. Patterson directed attention to the rotation of active compounds as modified by temperature, colour of light, and solution in indifferent liquids. It has been found that the rotation of certain compounds reaches a maximum at a definite temperature. This may indicate that one of the groups attached to an asymmetric carbon atom attains to a maximum influence. The theory is extended to afford a reason why anomalous dispersion should exist. The influence of the solvent in shifting the temperature-rotation curves so as to bring the parts in the neighbourhood of the maximum into view was demonstrated.

Unfortunately, time did not permit of a discussion of the views represented.

Lieut.-Col. J. W. Gifford described a partially corrected fluor-quartz lens for spectrum photography of a very high degree of accuracy. Dr. J. Hulme made a brief communication on crystalline-liquid substances.

Utilisation of Fuel.

The subject of the proper utilisation of coal and fuels derived therefrom was introduced before a large attendance by Prof. Armstrong, who urged that coal was burned wastefully and wrongly, and that certain issues ought to be brought prominently before the public. He deplored the exclusion of the chemist from the gas industry until quite recently, and considered gas and coke production should be associated in every large town. In the same way the methods of burning gas had been very inefficient until recently the chemist had come in. He asked for legislation to secure the proper use of coal, and urged the appointment of a royal committee of experts to organise and direct experimental work. The efforts of the remaining speakers were directed to show how economy had been secured in various branches of the subject as the result of the application of scientific inquiry.

Dr. Beilby dealt with low temperature carbonisation, describing for the first time a form of apparatus which he had devised in which coal could be exposed to the action of heat in thin layers. This consisted of a column heated externally in a gas-fired oven at 400° to 450°, and fitted internally with a series of sloping shelves. The coal was fed mechanically to the top of the column and the shelves jolted, so the coal passed over the whole series from top to bottom in a sheet of from 2 in. to 2½ in. in thickness. The time required was about an hour and a half, and a unit with a capacity of fifteen tons per day had been reached. He was satisfied that the production of a mechanically perfect apparatus into which small coal was automatically fed, passed through a distilling zone, and finally passed through a cooling chamber, only required a little more patient step by step development. Present disadvantages of the apparatus were that it would only work smoothly with non-caking coal and that it tended to break down the coal into small stuff. The coke from this plant had proved quite satisfactory in water-gas plant, and when aggregated into briquettes with about 7 per cent. of pitch it had proved eminently suited for domestic fuel.

Dr. H. G. Colman followed with a comprehensive account as to how far the gas industry was helping towards the economic use of fuel. The industry takes at present sixteen million tons of coal per annum. A steadily increasing proportion of the gas output is now employed for heating. The intrinsic luminosity of the gas was now only of minor significance, the calorific power being vastly more important. The cost at which gas was sold was steadily decreasing owing to greatly improved technological methods in the manufacture, to economies due to the larger scale on which operations were carried out, and to the increased value of some of the by-products.

Twenty-five per cent. of the heat units in the coal were obtained in the gas, 50 per cent. in the coke, and about 5 per cent. in the tar, the remainder being used in the process of manufacture. At present only about 20 per cent. of the nitrogen present in the coal is recovered in the form of ammonia. The efficiency of gas when used for lighting and for domestic heating and cooking was discussed, and its present increasing employment on a large scale for other industrial purposes was mentioned. In Birmingham this use accounts for some 8 per cent. of the total output.

Recent progress in gas-fire science was the subject summarised by Mr. H. James Yates. The drawbacks of the early gas fire were explained, and the evolution of the modern form of radiating fire, in which the fire-front consists of a series of hollow fire-clay columns (radiants), each flame rising into the cavity of its radiant, care being taken to prevent any infringement on the inner cone of the flame. Radiation has taken the place of convection as the mode of heat transference, and more than 50 per cent. of the net heat combustion of the gas is delivered as radiant energy. The author next enlarged on the testing of gas fires. The important question of ventilating effect was next considered. To ensure good ventilation without any sacrifice of radiant efficiency, an adequate vertical distance between the top of the radiants and the bottom of the canopy must be preserved. The entire change in the construction principle of gas fires was leading to their general adoption. To-day there were upwards of 350,000 gas fires in use in London alone.

Prof. W. A. Bone, who spoke at some length, dealt with the use of cheap gaseous fuel generated at or near the point at which it was to be used. He discussed the cost of generating water-gas and of ammonia-recovery producer gas, the latter being equivalent to coal-gas at 4*d*. per 1000 cubic feet. He outlined recent improvements in connection with a modern steel works plant which had led to the substitution of producer gas by a mixture of blast-furnace gas and coke-oven gas. This resulted in the abolition of the gas-producer with an economy of 2 to 3 cwt. of coal per ton of steel produced. Progress of this type represented an enormous economy in the use of coal; in addition, both tar and ammonia were recovered from the coal used.

Dr. R. V. Wheeler, speaking on the composition of coal, described a method of discriminating between coking and non-coking coals, his object being to explain the variations in the bituminous coals which cannot be accounted for by the differences which occur in their ultimate chemical composition. Coal was extracted with pyridine, and this extract separated further by partial solution in chloroform.

Dr. R. Lessing returned to the economics of domestic coal consumption, pointing out that any great increase in the use of coal-gas in the future would result in an over-production of gas-coke. He advocated more attention being paid to low-temperature carbonisation.

Mr. W. H. Patterson spoke with regard to the improvement of combustion and the blending of coals. The discussion then became general.

A lengthy paper by Messrs. J. F. Liverseege and A. W. Knapp entitled "The Action of an Alkaline Natural Water on Lead" concluded the sitting. The subject is now one of wide importance since so many of the large cities are now using very soft water gathered in distant hilly country. Such water may corrode or erode lead pipes, and requires treatment to prevent any danger arising from this action. The behaviour of the Birmingham water, gathered chiefly in Wales, towards lead pipes and sheet lead has been very thoroughly investigated by the authors, who find that given sufficient oxygen, the alkalinity of the water is the principal factor determining the amount of erosion. The use of lime as a preventative was not found satisfactory, but protection was given by the addition of four parts of calcium carbonate or two parts of calcium bicarbonate per 100,000. In practice a small proportion of powdered chalk is added to the water in Wales. The authors gave a full account of their methods of analysis. These were criticised by Prof. P. F. Frankland, who contended that the employment of Houston's test for determining the action of the water on lead was valueless, and that the only suitable test is to place the water in a corked lead pipe. The authors determined the alkalinity of the water by titration. This did not represent the true condition of the water, as it overlooked the dissolved carbon dioxide. He advised the use of Walker's method.

Radio-active Elements.

The discussion on radio-active elements and the periodic law attracted a very large audience. Unfortunately the counter-attractions of Sir J. J. Thomson's new gas limited it to an hour and a half, but Mr. Soddy, who opened it, was properly very brief. His main conclusion, based on the existence of chemically identical and non-separable groups of elements may be summarised as follows:—

The chemical analysis of matter is not an ultimate one. It has appeared ultimate hitherto, on account of the impossibility of distinguishing between elements which are chemically identical and non-separable unless these are in the process of change the one into the other. But in that part of the periodic table in which the evolution of the elements is still proceeding, each place is seen to be occupied not by one element, but on the average, for the places occupied at all, by no fewer than four, the atomic weights of which vary over as much as eight units. It is impossible to believe that the same may not be true for the rest of the table, and that each known element may be a group of non-separable elements occupying the same place, the atomic weight not being a real constant, but a mean value, of much less fundamental interest than has been hitherto supposed. Although these advances show that matter is even more complex than chemical analysis alone has been able to reveal, they indicate at the same time that the problem of atomic constitution may be more simple than has been supposed from the lack of simple numerical relations between the atomic weights.

The general law is that in an α-ray change, when a helium atom carrying two atomic charges of positive electricity is expelled, the element changes its place in the periodic table in the direction of diminishing mass and diminishing group number by two places. In a β-ray change, when a single atomic charge of negative electricity is expelled from the atom as a β particle, and also in the two changes for which the expulsion of rays has not yet been detected, the element changes its position in the table in the opposite direction by one place.

The discussion was continued by Mr. A. Fleck, who has determined experimentally what element each of the short-lived radio-elements most resembled, and whether it was separable from the ordinary element by fractional methods.

The results of the work show that:—

1. Uranium-X and radio-actinium are chemically identical with thorium.
2. Mesothorium-2 is chemically identical with actinium.
3. Radium-*A* is chemically identical with polonium.
4. Radium-*C*, thorium-*C*, actinium-*C*, and radium-*E* are chemically identical with bismuth.
5. Radium-*B*, thorium-*B*, and actinium-*B* are chemically identical with lead.
6. Thorium-*D* and actinium-*D* are chemically identical with thallium.

In the cases in which the inseparable elements are common elements these latter have all atomic weights above 200, and occupy one or other of the last twelve places of the periodic table.

Closely allied to the discussion was the next paper by Dr. G. Hevesy, entitled "Radio-active Elements as Indicators in Chemistry and Physics."

By means of an α-ray electroscope of ordinary sensitiveness it is possible to measure accurately as small a quantity as 10^{-17} grm. of a radio-active substance having a half-value period of one hour. The extraordinary simplicity and at the same time sensitiveness with which these extremely small quantities of radio-active bodies can be determined makes them of the greatest use not only in studying substances in great dilution, but also as indicators of physical and chemical processes. Radio-active indicators are conveniently divided into two principal groups. To the first group belong those the use of which as indicators depends only on their physical properties, and not on their chemical properties. Several examples of the use of indicators of this kind were given. The radio-active elements may be used chemically as indicators of the metals from which they are known to be non-separable. In this way 10^{-6} mg. of lead is quantitatively determinable.

The section then divided into physico-chemical and metallurgical divisions. After Dr. Patterson had communicated certain novel suggestions for the nomenclature of optically active compounds, two papers were read by Dr. B. de Szyszkowski, of Kieff. He first described the influence of sodium and potassium chloride in varying concentration upon the distribution of benzoic and salicylic acids. Both the affinity constant and partition coefficient were calculated. The former first rises, passes through a maximum, and then falls as the concentration of the salt is continually increased. Maxima of solubility are shown to exist for salicylic acid and 1 : 3 : 5-dinitrobenzoic acid. The increased solubility of acids in presence of salts is due to double decomposition and increase of the affinity constant, both factors contributing towards the diminution of the undissociated proportion of the acid.

The second paper dealt with solubility and distribution.

Dr. Prideaux, in a paper entitled "The Hydrogen Ion Concentration of the Sea and the Alkali-carbon-dioxide Equilibrium," supported the opinion that the interaction between the small quantities of carbon dioxide and free alkali is a most important factor controlling life in the sea and dealt at some length with the physico-chemical constants which connect the concentrations of the hydrogen and carbonate ions. It is supposed that the first and second dissociation constants of carbonic acid are both altered in saline solution. A lively discussion followed, in which Prof. Sörensen, Dr. Syzszikowski, and Dr. E. F. Armstrong took part.

Metallurgical Chemistry.

The metallurgical section sat separately on two mornings, Prof. T. Turner being in the chair. The first item was a discussion on metals, crystalline and amorphous, introduced by a paper from Dr. W. Rosenhain, who submitted advance proofs of the full paper to the meeting. The "amorphous" theory, as it now stands, appears to consist of three distinct propositions. The first of these is that mechanical disturbance of the material at the surface of a piece of crystalline metal, locally destroys the crystalline nature of the material and produces on the finished, polished surface a thin film of amorphous metal.

The second is that, just as friction and polishing of a metal surface produces a thin amorphous layer or film, so the internal rubbing which takes place on surfaces of internal slip when crystalline metal is plastically strained, will also bring about local disturbance resulting in the formation of a thin layer of amorphous metal. This amorphous metal is regarded as being less dense and much harder than the crystalline variety, and its formation is regarded as explaining the changes in hardness and density which are known to accompany plastic strain.

The third proposition is that where the constituent crystals of a metal meet, thin films of residual liquid metal will remain in circumstances which render them incapable of crystallising, so that they will constitute thin films of undercooled liquid or amorphous metal acting as an intercrystalline cement.

The author reviewed in detail how far these propositions can be regarded as established. The second in particular has been much criticised, but it was demonstrated that it offers an explanation for a larger number of facts than any rival theory.

In the subsequent discussion Dr. G. T. Beilby pointed out that interpenetration of the surface layer and the polishing powder is not essential, as calcite may be polished without any powder. The layers produced by polishing were not of molecular thinness, but really very deep. Unlike the author, he considered the microscopical evidence of a mobile phase in the interior of a strained metal conclusive.

Dr. C. H. Desch considered it necessary to distinguish between the hypothesis of amorphous phase in strained metal, due to Dr. Beilby, and that of an intercrystalline cement in unstrained metal, developed by Dr. Rosenhain. The first was now fully established; the second, although highly ingenious, was yet unproved. Most of the facts could be explained by the surface tension of the crystal grains.

Dr. Rosenhain, in reply, said that iron, unlike calcite, would not give a layer of amorphous material without the use of a powder. He could not agree that there would be any surface tension at the boundaries of crystals in contact.

In a paper by F. E. E. Lamplough and J. T. Scott it was stated that the "halos" sometimes seen around the crystallites in alloys containing a eutectic are not due to undercooling, but to segregation. They appear more readily when the alloy is slowly cooled, and their formation still occurs when undercooling is prevented by inoculation. By quenching experiments it is shown that the two constituents of a eutectic crystallise simultaneously, not alternately.

Prof. T. Turner's paper on the volatility of metals, especially under reduced pressure, was concerned with a subject in which there are considerable possibilities of future practical application. Distillation *in vacuo* is specially suitable for easily oxidisable metals such as sodium, potassium, cadmium, and zinc. Quantitative separations of the constituents of some alloys can readily be effected at suitable temperatures *in vacuo*. A general description of the work was given with particular reference to the influence of the pressure on the rate of volatilisation.

The structural changes brought about in certain alloys by annealing formed the subject of a paper by Mr. O. F. Hudson, which had reference mainly to those alloys which consist of a solid solution. On annealing, the cored structure characteristic of the cast alloy disappears and the crystals become quite uniform. Structurally the alloy does not now differ from a pure metal. Alloys which have been worked before annealing practically became recrystallised during the process. In the case of alloys consisting of crystals of two or more kinds, the chief effect of annealing is to promote equilibrium between the two phases present. Prolonged annealing is required to attain complete phase and structural equilibrium. The paper gave a valuable summary of the existing knowledge on the subject.

In a paper on diffusion in solid solutions, Dr. C. H. Desch alluded to the fact that since his report to the Dundee meeting of the association, Bruni and Meneghini have succeeded in demonstrating the occurrence of diffusion in a clear, crystalline solid in the case of sodium and potassium chlorides. A mixture of these two salts, heated at 500° or 600°, yields a homogeneous solid solution, the formation of which is recognised by determining the heat of solution in water, which differs from that of a mechanical mixture. The author's further experiments with metallic alloys show that a sharp boundary is characteristic of diffusion in solids when a chemical compound is formed. An abrupt discontinuity of composition is also observed when one component is removed by solution, as in the dezincification of alloys of copper and zinc.

Mr. E. Vanstone described the methods and results of determinations of the electrical conductivity of sodium amalgams when in the solid state.

The work described by Dr. A. Holt in a paper entitled "The Solubility of Gases in Metals" had reference mainly to the solubility of hydrogen in palladium, but there seems distinct evidence that the phenomena are not peculiar to this case, but occur also with other metals and gases.

Rapid solution of gas appears only to take place when the metal is in an amorphous condition. The metal may be wholly amorphous, as in the case of palladium black, or it may have an amorphous surface associated with amorphous films round the crystals of the otherwise holocrystalline material. The rate of solution appears to depend on the amount of amorphous metal present, hence when the amorphous and crystalline phases are in physical contact, the metastable amorphous phase tends to crystallise, and so causes a falling off in the rate of solution. When, however, the amorphous phase alone is present, the rate of change is so excessively slow that the rate of solution appears to be a constant, even after a long period of years.

The activity can be increased up to a maximum value by repeated saturation and removal of gas from the metal. According to Beilby, "the gas molecules as they find their way among the metal molecules of the solid are quite capable of producing sufficient movement to arrest crystallisation, or even to flow the crystals which are already formed into the amorphous variety," and this would explain the above-mentioned increase in activity.

Since, however, all forms of the metal appear eventually to dissolve almost the same volumes of gas, it must be concluded that when the metal is mainly crystalline, the amorphous phase functions as a vehicle for the transference of gas, for some amorphous metal is always present in physical contact with the crystalline phase.

Dr. R. E. Slade and Mr. G. I. Higson contributed two papers. The first, on the equilibria of reduction of oxides by carbon, described the methods followed to determine the equilibrium temperature and pressure of carbon monoxide for vanadium, tantalum, chromium, tin. The second described the determination in a similar manner of the dissociation pressures and temperatures of the nitrides of vanadium, tantalum, and boron.

Mr. F. D. Farrow gave a concise summary of the recent work on the melting points and dissociation pressures of the system copper oxygen, the data being collected to form temperature-composition and temperature-pressure diagrams. The influence of traces of impurities on the properties of copper was surveyed by Mr. F. Johnson, who urged the importance of metallurgical testing and analysis and the use of the microscope in studying the commercial brands of crude copper for practical use.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed to confer the degree of Master of Arts, *honoris causâ*, upon Mr. W. Dawson, reader in forestry

Dr. A. S. F. Grünbaum, of Gonville and Caius College, and Mr. F. R. C. Reed, of Trinity College, have been approved by the General Board of Studies for the degree of Doctor of Science.

Mr. F. T. Brooks, of Emmanuel College, is leaving England for the Federated Malay States, in order to make a report to the Government on the fungoid diseases and as to whether anything can be done to arrest them. Mr. Brooks has received one year's leave of absence from the University.

OXFORD.—It is proposed to raise a memorial to the late Dr. Francis Gotch, Waynflete professor of physiology in the University. The form taken by the memorial will be determined by the success of the appeal which is being made to the friends and former pupils of the late professor in London, Liverpool, Oxford and elsewhere. In a circular that has been issued by the provisional committee, which includes the names of the Dean of Christ Church (Vice-Chancellor), the heads of Magdalen, Brasenose, and Keble, Profs. Bayliss, Bourne, Dreyer, Elliott, Sir W. Osler, Poulton, Sir Walter Raleigh, Sherrington, Arthur Thomson, H. H. Turner, and Dr. J. S. Haldane, attention is directed to his strenuous work in physiology and his wide sympathies in other branches of science and in art. Subscriptions may be sent to either of the secretaries (Dr. W. Ramsden, Pembroke College, and Dr. H. M. Vernon, Magdalen College), or to Messrs. Barclay and Co., Ltd., Old Bank, Oxford.

The electors to the Waynflete professorship of physiology have elected Dr. C. S. Sherrington F.R.S., Holt professor of physiology in the University of Liverpool, to succeed Dr. Gotch.

An appeal is issued for the endowment of a professorship of forestry at Oxford. In no branch of exact knowledge is this country more backward than in scientific forestry. Chairs of forestry at the universities have existed on the Continent for more than a century. The higher forest instruction is now firmly established in tne United States of America. The Oxford Forest School has for many years been at the head of scientific forestry teaching in the British Empire. Founded originally for the training of Indian forest students, it has grown steadily under Sir William Schlich's guidance. It is no longer mainly occupied with the training of Indian forest officers. Of the thirty-five students at present under instruction only seven are destined for India. South Africa, which in forest organisation is some quarter of a century ahead of the other British Colonies, has long had its forest officers trained under Sir William Schlich. The appeal now issued states that a total of 3,744*l.* has been raised out of 10,000*l.* required to secure permanently a fully competent professor of forestry. In the list of contributions, Sir W. Schlich and his pupils appear at the head with 500*l.*, and a like sum is contributed by the Secretary of State for India and by four other Colonial Governments. The Oxford colleges promise donations amounting to 875*l.*, and St. John's College, Oxford, 50*l.* a year permanently. When we reflect on 30,000,000*l.* going yearly out of this country to pay for the timber and paper pulp that could demonstrably be produced in it (Cd. 4460, 1909), and that this huge amount of rural employment is lost to us yearly, it will be seen that the appeal for the endowment of a chair of forestry at Oxford has claims that in the truest sense are national as well as scientific.

SIR RICKMAN GODLEE, president of the Royal College of Surgeons, has had the honorary degree of Doctor of Laws conferred upon him by the University of Toronto.

THE University of Bristol has made a regulation whereby the Bath Municipal Technical School will be connected with the faculty of engineering of the University, which is provided and maintained in the Merchant Venturers' Technical College. It will be possible for a student to take the preliminary and intermediate courses for the University certificate in engineering, either in whole or in part in evening classes in the Bath Technical School, provided that the classes included in them have been approved by the Senate, and are conducted by teachers recognised by the Senate for the particular purpose.

WE learn from the issue of *Science* for October 31 last that the General Education Board of the United States, in addition to a gift of 280,000*l.* to the Johns Hopkins Medical School, to provide professorial salaries which will enable the professors to be independent of private work, has made conditional grants of 40,000*l.* for Barnard College, Columbia University; 40,000*l.* for Wellesley College, and 10,000*l.* for Ripon College. From the same source we find that two gifts have been made to the Massachusetts Institute of Technology from anonymous donors, sums of 100,000*l.* and 20,000*l.* respectively. There is an understanding that the larger gift is to be used for the buildings, while the other has no restrictions. By the will of the late Mr. Simeon Smith, of Indiana, DePauw University has recently added 16,000*l.* to its productive endowment. By the terms of the will, 10,000*l.* of this amount has been set aside specifically as an endowment of the department of chemistry.

THE Board of Agriculture and Fisheries is not allowing the grass to grow under its feet, and in furtherance of its educational schemes for the benefit of agriculture it has just issued a memorandum (Cd. 7118) "as to the constitution of the advisory councils for agricultural education in England and of the agricultural council for Wales." The Rural Education Conference recommended that joint councils should be constituted in each of the twelve divisions which were being formed in England and Wales in connection with the Board's scheme for the provision of technical advice to farmers, and that their duties should primarily be to promote the organisation of the different forms of agricultural instruction which are not provided for inside the agricultural colleges forming the divisional centres. The first appendix to the memorandum sets out in detail the steps which have been taken to establish such advisory councils in nine of the ten divisions which cover England, with particulars as to their constitution and membership. No formal steps have, as yet, been taken to constitute such a council for Lancashire and Cheshire. The Board has rejected the proposal of the conference to establish two councils for Wales, and has preferred to constitute a single agricultural council for Wales and Monmouth. Details of its constitution are given in Appendix II. The function of these councils is twofold:—(*a*) Educational, including the assistance and advice of local education authorities on such points as the organisation and coordination of agricultural education each within its sphere of action, provision of agricultural experiments, demonstrations, and instructors, inquiry into the need for farm schools and other educational centres of a type less advanced than the agricultural colleges, and so forth; (*b*) advisory: to keep the Board informed on the state of agricultural education within their respective provinces, and, through a live-stock committee, to assist the Board in furthering its schemes for the improvement of the live-stock of the country. Further developments will be watched with keen interest by all who have the welfare of British agriculture at heart.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 6.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. E. W. **MacBride**: Studies in heredity. II., Further experiments in crossing the British species of sea-urchins. In this paper the results obtained two years ago and communicated to the society are confirmed and extended. The hybrid produced by fertilising the egg of Echinus with the sperm of Echino-cardium is described. This hybrid was not obtained two years ago. The effect of foreign sperm in producing cytolysis on an egg is described, and it is also shown that an egg may become totally unreceptive for foreign sperm, whilst it is still perfectly capable of being fertilised with the sperm of its own species.—A. D. **Hall**, W. E. **Brenchley**, and L. M. **Underwood**: The soil solution and the mineral constituents of the soil.—Prof. B. **Moore** and T. A. **Webster**: Synthesis by sunlight in relationship to the origin of life. Synthesis of formaldehyde from carbon dioxide and water by inorganic colloids acting as transformers of light energy.—Dr. B. **Blacklock** and Dr. W. **Yorke**: The trypanosomes causing dourine (mal de coït or Beschälseuche).—T. G. **Brown**: Postural and non-postural activities of the mid-brain.—J. O. W. **Barratt**: The nature of the coagulant of the venom of *Echis carinatus*.—E. H. **Rodd**: Morphological studies in the benzene series. IV., The crystalline form of sulphonates in relation to their molecular structure.—Prof. W. H. **Bragg** and W. L. **Bragg**: The structure of the diamond.—Hon. R. J. **Strutt**: Note on electric discharge phenomena in rotating silica bulbs.—J. N. **Pring**: The origin of thermal ionisation.—Clive **Cuthbertson** and Maude **Cuthbertson**: The refraction and dispersion of gaseous nitrogen peroxide.

Physical Society, October 24.—Prof. C. H. Lees, vice-president, in the chair.—Ezer **Griffiths**: The ice calorimeter, with remarks on the constancy of the density of ice. The primary object of the work was the redetermination, by an electrical method, of the constant of Bunsen's ice calorimeter. The mean value of the calorimeter constant was found to be 15·486 milligrams of mercury per mean calorie. Various observers have advanced evidence tending to show that the density of ice at 0° C. is not a definite constant. A consideration of their work leads to the conclusion that the small variations of density found for different samples might be simply due to the presence of occluded water or an amorphous modification cementing the ice crystals together. The value (80·30) of the latent heat of fusion of ice, calculated from the ice calorimeter, supports this view, as it is higher by about 0·7 per cent. than the value obtained by direct determinations with ice in bulk.—H. **Ho** and S. **Koto**: An electrostatic oscillograph. The paper describes an electrostatic oscillograph suitable for recording very high voltages. Two vertical bronze strips pass symmetrically between two parallel metallic plates called "field plates." They are connected at their lower ends by a silk fibre which passes under an ivory pulley. An extremely small mirror is fixed to the strips. This arrangement constitutes the vibrator, which, mounted on an ebonite frame, is immersed in an oil bath. To the upper extremities of the strips are connected the terminals of a direct-current voltage of about 300. The alternating voltage to be recorded is connected to the "field plates," in parallel with which there are two oil condensers in series. The electrical midpoint of the direct-current battery is connected to a point between the condensers. The turning moment on the strips is proportional to the product of the momentary values of the alternating-current voltage and the direct-current voltage, so that if the latter is constant, the deflection of the mirror accurately follows the variation of the former.

Zoological Society, October 28.—Prof. E. A. Minchin, F.R.S., vice-president, in the chair.—Dr. F. E. **Beddard**: The anatomy and systematic arrangement of the Cestoidea. A new genus and species of tapeworms from the double-striped thicknee (*Œdicnemus bistriatus*) was described.—Dr. F. A. **Bather**: The fossil Crinoids referred to Hypocrinus Beyrich. The two specimens of *Hypocrinus schneideri*, Beyr., described by Beyrich and Rothpletz respectively, are re-described and re-figured. The structure of the genus is shown to agree with that of the Devonian family Gasterocomidæ, the content of which is discussed; but it is suggested that in this case and in that of "*Lecythiocrinus*" *adamsi* the distinctive features may have been independently acquired. The holotype of *Hypocrinus piriformis*, Rothpletz, is redescribed and refigured, and proved to be no Hypocrinus. It is thought to be a highly modified descendant of the Taxocrinidæ, by way of such a genus as Cydonocrinus. The left posterior radial appears to have borne a large arm, but the other arms are more or less atrophied, and the right posterior radial has almost disappeared.—D. M. S. **Watson**: *Batrachiderpeton lineatum*, Hancock and Atthey, a Coal-Measure Stegocephalian. The paper contained the description of the skull, lower jaw, and pectoral girdle of this species, based on a series of specimens in the Newcastle Museum, derived from the low main seam of Newsham Colliery.—R. W. **Palmer**: The brain and brain-case of a fossil ungulate of the genus Anoplotherium. A cranium from the Phosphorites of Quercy, together with an exceptionally perfect and well-marked brain-cast obtained from it, were described from material in the British Museum collections.

Challenger Society, October 29.—Sir John Murray in the chair.—Dr. E. J. **Allen**: A new quantitative tow-net for the collection of plankton. A net of bolting-silk is enclosed within a canvas case so arranged that all the water passing through the net escapes from the canvas case through a meter The meter consists of a propeller and a clockwork recorder, and is calibrated by running through it a measured stream of water. The number of organisms collected by the net can be counted or the amount of plankton determined in some other way, and the quantity per unit volume of water calculated. The net can be used for horizontal or for vertical hauls, in the latter case working both when going down and when coming up.—Dr. Francis **Ward**: Reflection as a concealing and revealing factor in aquatic life.

Manchester.

Literary and Philosophical Society, October 7.—Mr. Francis **Nicholson**, president, inaugural address: The old Manchester Natural History Society and its museums. An account of the society, which existed from 1821 to 1868, first in St. Anne's Place, afterwards in King Street, and from 1835 in a museum built for the purpose in Peter Street. The museum was eventually passed over to Owen's College, in trust for the people of Manchester, and exists to-day, improved out of recognition, as the Manchester Museum. The museum was perhaps strongest in the class of birds, in which it once rivalled the British Museum. As trustees, the University are now carrying on the work initiated by the Natural History Society much more efficiently than the society did in its most prosperous days.—Prof. F. E. **Weiss**: Juvenile flowering in *Eucalyptus globulus*. A young plant developed flower buds during its second year, after the main stem had been cut down. The flowers were subtended by leaves characteristic of the immature plant and very different from the mature foliage. Such occurrences have been recorded for one or two species of Australian Eucalypti. In the case described by the author, the interference with the growth of the plant seems to have led to the juvenile flowering, as another plant dealt with in a similar way has produced flowers on the lateral branch, which had taken the place of the main stem after the latter was cut down.

October 21.—Mr. Francis Nicholson, president, in the chair.—Miss D. A. **Stewart**: Changes in the branchial lamellæ of *Ligia oceanica* after prolonged immersion in fresh- and salt-water. *Ligia oceanica*, the quay-slug, is found at various heights above high-water mark, but not far inland, and has congeners which inhabit fresh-water or are amphibious or terrestrial. The gills of these forms are similar, and Miss Stewart carried out experiments to determine the effect upon the gill structure of prolonged immersion in sea-water and fresh-water.

PARIS.

Academy of Sciences, November 3.—M. F. Guyon in the chair.—A. **Haller**: The alkylation of the β- and γ-methyl*cyclo*hexanones by means of sodium amide. The reaction between sodium amide, methyl*cyclo*hexanone, and ethyl iodide gives a condensation product of the ketone in addition to the substituted ethyl derivatives. Details are given of the variation of this secondary reaction with the experimental conditions. —A. **Laveran** and G. **Franchini**: Experimental infections of mammals by the flagellæ of the digestive tube of *Ctenocephalus canis* and *Anopheles maculipennis*. Flagellæ from both sources are equally capable of infecting the mouse and rat.—Pierre **Termier**: The excursion C1 of the twelfth International Geological Congress. The Pre-Cambrian strata of the Lake region; the tectonic problems of the great chains of the west.—E. **Belot**: Zodiacal matter and the solar constant. A discussion of the perturbations due to zodiacal matter, the reflection of sunlight upon the same, and the variations of the solar constant due to absorption by zodiacal matter.—M. **Giacobini**: The comet 1913*e*. Position of the Zinner comet on November 1. The comet appeared as a round nebulosity of about 45″ diameter, with a nucleus of about 9·5 magnitude. There were indications that the light from the comet was polarised.—M **Couadé**: An aviation parachute. A description of experiments made with small-scale models.—P. **Helbronner**: The complementary geodesic triangulations of the higher regions of the French Alps.—Bohdan de **Szyszkowski**: The rôle of the neutral molecule in electrolytes.—B. **Szilard**: A direct reading static voltmeter for the measurement of very small currents. —Thadée **Peczalski**: Compressibility and the differences of the specific heats of liquids.—Georges **Baume**: Some physico-chemical applications of the Maxwell-Barthoud distribution equation.—Eugène L. **Dupuy** and A. **Portevin**: The influence of various metals on the thermo-electric properties of the iron-carbon alloys. Sixty alloys were studied, the elements added to the iron-carbon alloy including chromium, manganese, aluminium, tungsten, and molybdenum. The thermo-electric power was measured over the ranges $-78°$ C. to $0°$, and $0°-100°$.—Amé **Pictet** and Maurice **Bouvier**: The distillation of coal under reduced pressure. The coal was heated to about 450° C., and the pressure in the retort maintained at about 16 mm. The aqueous portion of the distillate was acid, and contained no ammonia. The tar contained neither phenols nor naphthalene, but the presence of secondary bases was proved. The hydrocarbons belonged nearly exclusively to the fatty series. —Aug. **Rilliet** and L. **Kreitmann**: 6-Aminopiperonal.—Pierre **Lesage**: Contribution to a critical examination of the action of atmospheric electricity upon plants.—J. **Beauverie**: Frequent presence of the germs of rust in the interior of the seeds of the Graminaceæ.—R. **Robinson**: The physiology of the cæcal appendix. The hormone of the vermium.—Raoul **Bayeux**: A new distributing gas micrometer for use in intravenous injections.—Jules **Amar**: The respiratory signs of fatigue.—L. C. **Soula**: The mechanism of anaphylaxis. —Gabriel **Bertrand** and A. **Compton**: The presence of a new diastase, salicinase, in almonds.—C. **Gessard**: The salts in the coagulation of the blood.—Fred **Vlès**: The absorption of the visible rays by the blood of the octopus.—Louis **Gentil** and Pereird de **Sousa**: The effects in Morocco of the great earthquake in Portugal of 1755.

NEW SOUTH WALES.

Linnean Society, September 24.—Mr. W. S. Dun, president, in the chair.—W. N. **Benson**: The geology and petrology of the great Serpentine belt of New South Wales. Part ii., the geology of the Nundle district. The formations present are, the Woolomi Series, the Bowling Alley Series (equivalent to the Tamworth Series), of which five divisions are recognised; and the Nundle Series, equivalent to the Barraba Mudstones. The last lies conformably on the Bowling Alley Series, for the Baldwin Agglomerates are not developed. The first two contain numerous interstratified flows of spilite, and, in the second, sills of albitised dolerite are abundant. All three contain radiolaria. A well-marked Middle Devonian limestone horizon runs throughout the Bowling Alley Series.—E. C. **Andrews**: The development of the natural order Myrtaceæ. The Myrtaceæ are widely distributed over the tropical and subtropical regions of the world, particularly in the fertile tropics. The number of species is approximately 3100 (America, 1670; Australia, about 800; Asia, about 235; Africa, 85; Malay Archipelago and Pacific Islands, 310 species; Europe only one). By far the greater number of these are of luxuriant types, possessing fleshy and indehiscent fruits. The capsular genera are endemic in Australasia and the neighbouring regions, and the majority of the species grow on poor sandy soil, and are strikingly depauperate in nature, compared with the widely spread genera, such as the Myrtles, Guavas, and Eugenias. Whereas Ettingshausen considers the modern endemic flora of Australia as being of cosmopolitan range in early and later Tertiary time, the present author considers the present endemic flora of Australia as being the depauperate descendants of luxuriant and cosmopolitan types of the Cretaceous and Eocene periods.—R. T. **Baker**: Descriptions of three new species of the natural order Myrtaceæ. Two species of Melaleuca from littoral Eastern Australia, and one of Angophora from the New England district, are described as new.

BOOKS RECEIVED.

Index of Spectra. By Dr. W. M. Watts. Appendix v. Pp. iv+92. (London: W. Wesley and Son.)

Die radioaktive Strahlung als Gegenstand wahrscheinlichkeitstheoretischer Untersuchungen. By Prof. L. v. Bortkiewicz. Pp. 84. (Berlin: J. Springer.) 4 marks.

The Life of the Fly, with which are Interspersed some Chapters of Autobiography. By J. H. Fabre. Translated bv A. T. de Mattos. Pp. xi+508. (London: Hodder and Stoughton.) 6*s*. net.

The Diesel or Slow Combustion Oil Engine. By Prof. G. J. Wells and A. J. Wallis-Tayler. Pp. xvi+286. (London: Crosby Lockwood and Son.) 7*s*. 6*d*. net.

Key to "A New Algebra." Vol. ii., containing parts iv., v., and vi. By S. Barnard and J. M. Child. Pp. 447–915. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*.

Ministry of Finance, Egypt. Survey Department. The Rains of the Nile Basin and the Nile Flood of 1911. By J. I. Craig. Pp. 110+viii plates. (Cairo: Government Press.) P.T.10.

The Johns Hopkins University Circular, 1913, No. 8. Catalogue and Announcement for 1913–14 of the Medical Department Established in Connection with the Johns Hopkins Hospital. Pp. 276. (Baltimore, Md.)

Our Common Sea-Birds: Cormorants, Terns, Gulls, Skuas, Petrels, and Auks. By P. R. Lowe. Pp. xvi+310. (London: *Country Life*, Ltd.) 15*s*. net.

The Archæology of the Anglo-Saxon Settlements. By E. T. Leeds. Pp. 144. (Oxford: Clarendon Press.) 5*s*. net.

University College of North Wales. Calendar for the Session 1913–14. Pp. 446. (Manchester: J. E. Cornish, Ltd.)

Le Scienze Esatte Nell' Antica Grecia. By Prof. G. Loria. Seconda edizione. Pp. xxiv+970. (Milano: U. Hoepli.) 9.50 lire.

Opere Matematiche di Luigi Cremona. Tomo Primo. Pp. viii+497. (Milano: U. Hoepli.) 25 lire.

Cement, Concrete, and Bricks. By A. B. Searle. Pp. xi+412. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

Dysenteries: their Differentiation and Treatment. By Prof. L. Rogers. Pp. xi+336+x plates. (London: H. Frowde and Hodder and Stoughton.) 10*s*. 6*d*. net.

Milton's Astronomy: The Astronomy of "Paradise Lost." By Dr. T. N. Orchard. Pp. xi+288+plates. (London: Longmans and Co.) 7*s*. 6*d*. net.

Scott's Last Expedition. In two vols., vol. i. being the Journals of Capt. R. F. Scott, R.N., C.V.O. Pp. xxvi+633+plates; vol. ii. being the Reports of the Journeys and the Scientific Work undertaken by Dr. E. A. Wilson and the Surviving Members of the Expedition. Arranged by L. Huxley. With a Preface by Sir Clements R. Markham, K.C.B. Pp. xiv+534+plates. (London: Smith, Elder and Co.) 42*s*. net the two vols.

Notions fondamentales de Chimie Organique. By Prof. C. Moureu. Quatrième édition. Pp. 383. (Paris: Gauthier-Villars.) 9 francs.

The Library Association Book Production Committee. Interim Report. Pp. 32. (London: Library Association.) 1*s*. net.

Report of the Bombay Bacteriological Laboratory for the Year 1912. By Major W. G. Liston Pp. 39. (Bombay: Government Central Press.) 5 annas, or 6*d*.

Ueber Neo-Vitalismus. By E. du Bois-Reymond. Edited by E. Metze. Pp. 60. (Brackwede i.W.: Dr. W. Breitenbach.) 1 mark.

Transactions of the Royal Society of Edinburgh. Vol xlix., part 2 (No. 3). A Monograph on the General Morphology of the Myxinoid Fishes, based on a Study of Myxine. Part v., The Anatomy of the Gut and its Appendages. By Prof. F. J. Cole. Pp. 293–344+plates. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 6*s*. 3*d*.

The Elements of Descriptive Astronomy. By E. O. Tancock. Pp. 110+xv plates. (Oxford: Clarendon Press.) 2*s*. 6*d*. net.

Papers of the British School at Rome. Vol. vi. Pp. xiv+511+xl plates. (London: Macmillan and Co., Ltd.) 42*s*. net.

Clinical Bacteriology and Vaccine Therapy for Veterinary Surgeons. By W. Scott. Pp. xiv+222+xii plates. (London: Ballière, Tindall and Cox.) 7*s*. 6*d*. net.

Chemische Technologie der Gespinstfasern. By Dr. K. Stirm. Pp. xvi+410. (Berlin: Gebrüder Borntraeger.) 12 marks.

A Text-book of Elementary Statics. By Prof. R. S. Heath. Pp. xii+284. (Oxford: Clarendon Press.)

All Men are Ghosts. By L. P. Jacks. Pp. ix+360. (London: Williams and Norgate.) 5*s*. net.

Institut de Paléontologie Humaine. La Pasiega. A. Puente-Viesgo (Santander), Espagne. By Prof. H. Breuil, Prof. H. Obermaier, and H. Alcalde del Rio. Pp. 64+xxix plates. (Monaco: A. Chêne.)

Hope and Help. Golden Advice on the Overcoming of the Drink Habit. By One Who Cured Himself. Pp. 44. (London: A. M. King and Co.) 1*s*.

The Cambridge Manuals of Science and Literature. The Fertility of the Soil. By Dr. E. J. Russell. Pp. iv+128+plates. The Life-Story of Insects. By Prof. G. H. Carpenter. Pp. iv+134. The Peoples of India. By J. D. Anderson. Pp. xii+118+vii plates. Pearls. By Prof. W. J. Dakin. Pp. viii+144. Natural Sources of Energy. By Prof. A. H. Gibson. Pp. viii+131. The Flea. By H. Russell. Pp. xi+125. (Cambridge University Press.) Each 1*s*. net.

The Ideals and Organisation of a Medical Society. By Dr. J. B. Hurry. Pp. 51. (London: J. and A. Churchill.) 2*s*. net.

Carbon Dioxide Snow: its Therapeutic Uses (Methods of Collection and Application). By J. Hall-Edwards. Pp. xv+78+plates. (London: Simpkin and Co., Ltd.) 3*s*. 6*d*.

Introduction to Biology. By Prof. M. A. Bigelow and A. N. Bigelow. Pp. xi+424. (London: Macmillan and Co., Ltd.) 6*s*.

Letters and Recollections of Alexander Agassiz, with a Sketch of his Life and Work. Edited by G. R. Agassiz. Pp. xi+454+plates. (London: Constable and Co., Ltd.) 14*s*. net.

Philips' Nature Calendar, 1914. (London: G. Philip and Son, Ltd.) 6*d*. net.

Cassell's Natural History. By F. M. Duncan. Pp. xx+432+plates. (London: Cassell and Co., Ltd.) 9*s*. net.

The British Empire Universities Modern English Illustrated Dictionary. Edited by E. D. Price and Dr. H. T. Peck. Pp. lxxx+1008+plates. (London: The Syndicate Publishing Co.) 20*s*.

Farm and Creamery Buttermaking and Students' Reference Book. By C. W. Walker-Tisdale and T. R. Robinson. Third revision. Pp. 194. (London: *Dairy World and British Dairy Farmer*.) 3*s*. 6*d*. net.

Fishery Board for Scotland. Fifth Report (Northern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters. Conducted for the Fishery Board for Scotland in Co-operation with the International Council for the Exploration of the Sea, under the Superintendence of D'Arcy W. Thompson, 1908–11. Pp. vi+404+plates. (London: H.M.S.O.; Wyman and Sons, Ltd.) 14*s*.

A History and Description of the Royal Observatory, Cape of Good Hope. By Sir D. Gill. Pp. cxc+136+plates. (London: H.M.S.O.)

Studien zur Pathologie der Entwicklung. By Dr. R. Meyer. Edited by Dr. E. Schwalbe. Erster Band, Erstes Heft. Pp. iii+196+iii plates. (Jena: G. Fischer.) 8 marks.

Dansk Botanisk Arkiv. Bind i., No. 1. By E. Ostrup. Pp. 40+plate. Bind i., No. 2. By M. Vahl. Pp. 18. Bind i., No. 3. By O. Galloe. Pp. 119. Bind i., No. 4. By F. Borgesen. Pp. 160. (Kobenhavn: H. Hagerups Boghandel.) Prices various.

Beiträge zur Kenntnis der Kapverdischen Inseln. Die Ergebnisse einer Studienreise im Sommer 1912. By I. Friedlaender. Gesteine der Kapverdischen Inseln. By Prof. W. Bergt. Pp. xii+109+xix plates. (Berlin: D. Reimer.) 15 marks.

Matter and Some of its Dimensions. By W. K. Carr. Pp. 120. (London: Harper and Bros.) 2s. 6d. net.

Mountains: their Origin, Growth and Decay. By Prof. J. Geikie. Pp. xix+311+plates. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson.) 12s. 6d. net.

A Dictionary of Applied Chemistry. By Sir E. Thorpe, assisted by Eminent Contributors. Revised and enlarged edition. Vol. v. Pp. viii+830. (London: Longmans and Co.) 45s. net.

A Treatise on Chemistry. By H. E. Roscoe and C. Schorlemmer. Vol. ii., The Metals. New edition, completely revised by the Right Hon. Sir H. Roscoe and others. Pp. xvi+1470. (London: Macmillan and Co., Ltd.) 30s. net.

Gardens of the Great Mughals. By C. M. V. Stuart. Pp. xviii+290+xl plates. (London: A. and C. Black.) 12s. 6d. net.

The Gannet: a Bird with a History. By J. H. Gurney. Pp. li+567+plates. (London: Witherby and Co.) 27s. 6d. net.

Canada: Department of Mines. Mines Branch. A General Summary of the Mineral Production of Canada during the Calendar Year 1912. Pp. 46. (Ottawa: Government Printing Bureau.)

New Zealand. Department of Lands and Survey. Report on the Survey Operations for the Year 1912–13. By J. Mackenzie. Pp. 77+maps. (Wellington: J. Mackay.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 13.

ROYAL SOCIETY, at 4.30.—The Preparation of Eye-preserving Glass for Spectacles: Sir William Crookes, O.M.—An Inversion Point for Liquid Carbon Dioxide in regard to the Joule-Thomson Effect: Prof. A. W. Porter.—Negative After-Images and successive Contrast with Pure Spectral Colours: Prof. A. W. Porter and Dr. F. W Edridge-Green.—The Positive Ions from Hot Metals: Prof. O. W. Richardson.—(1) The Diurnal Variation of Terrestrial Magnetism.—(2) A Suggestion as to the Origin of Black Body Radiation: G. W. Walker.

CONCRETE INSTITUTE, at 7.30.—Presidential Address: E. P. Wells.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Pressure Rises: W. Duddell.

FRIDAY, NOVEMBER 14

ROYAL ASTRONOMICAL SOCIETY, at 5.—Note on a Method of Balancing Dome Shutters: W. H. Maw.—Mean Areas and Heliographic Latitudes of Sun-spots in the Year 1912: Royal Observatory, Greenwich.—Reply to Mr. Denning's "Observations of the Orionids": C. P. Olivier.—The Expression of Sun-spot Frequency as a Fourier Sequence, and on the General Use of a Fourier Sequence in Similar Problems: H. H. Turner.—Further Note on the Possibility of Refraction by the Solar Atmosphere: R. S. Capon.—Sixth Note on the Number of Faint Stars with Large Proper Motions: F. A. Bellamy.—Seventh Note on the Number of Faint Stars with Large Proper Motions: R. J. Pocock.—The Dynamics of a Globular Stellar System: A. S. Eddington.—*Probable Papers:* Retrograde Satellite Orbits: J. Jackson.—(1) Photographic Magnitudes of 265 Stars within 25° of the North Pole; (2) The Application of Parallel Wire Diffraction Gratings to Photographic Photometry: S. Chapman and P. J. Melotte.

PHYSICAL SOCIETY, at 8.—On the Thermal Conductivity of Mercury by the Impressed Velocity Method: H. R. Nettleton.—On Polarisation and Energy Losses in Dielectrics: Dr. A. W. Ashton.—A Lecture Experiment to illustrate Ionisation by Collision and to show Thermoluminescence: F. J. Harlow.

ALCHEMICAL SOCIETY, at 8.15 (at The International Club, Regent Street, S.W.)—The Hermetic Mystery: Mme. Isabelle de Steiger.

MONDAY, NOVEMBER 17.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—Annual General Meeting.—The Institution: E. King.

TUESDAY, NOVEMBER 18.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Evidential Value of the Historical Traditions of the Baganda and Bushongo: E. S. Hartland.

ROYAL STATISTICAL SOCIETY, at 5.—The Course of "Real Wages" in London, 1900–1912: Frances Wood.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Report on Progress during the Vacation: L. Gaster.—Proceedings at the National Gas Exhibition: F. W. Goodenough.—The Fourth International Congress on School Hygiene: Dr. J Kerr.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* The Construction of the "White Star" Dock and adjoining Quays at Southampton: F. E. Wentworth-Sheilds.

WEDNESDAY, NOVEMBER 19.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Daily Temperature Range at Great Heights: W. H. Dines.—Eddy Wind of Gibraltar: H. Harries.

GEOLOGICAL SOCIETY, at 8.—Exhibition of Implements and Reputed Implements of Palæolithic or Earlier Age, and of Flints showing Various Types of natural Fracture, followed by a Discussion.

AËRONAUTICAL SOCIETY, at 8.30.—The Right to Fly: Roger Wallace, K.C.

ROYAL SOCIETY OF ARTS, at 8.—Opening Meeting. Address by Col. Sir T. H. Holdich, K.C.M.G.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Notes on the Shell Structure in the Genus Lingula, Recent and Fossil: F. W. Chapman.—Development of an Embiid: J. C. Kershaw.

THURSDAY, NOVEMBER 20.

ROYAL SOCIETY, at 4.30.—*Probable Papers: Medullosa Pusilla:* Dr. D. H. Scott.—Neuro-muscular Structures in the Heart: Prof. A. F. S. Kent.—The Alleged Excretion of Creatine in Carbohydrate Starvation: G. Graham and E. P. Poulton.—The Origin and Destiny of Cholesterol in the Animal Organism. XI. The Cholesterol Content of Growing Chickens under Different Diets: J. A. Gardner and P. E. Lander.—Contributions to the Biochemistry of Growth—The Lipoids of Transplantable Tumours of the Mouse and the Rat: W. E. Bullock and W. Cramer.

FRIDAY, NOVEMBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Cutting Power of Lathe Turning Tools: Prof. W. Ripper and G. W. Burley.

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No. 2293, Vol. 92] THURSDAY, NOVEMBER 20, 1913 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

UNIVERSITY OF LONDON.

THIS IS TO GIVE NOTICE that the Senate will shortly proceed to elect Examiners in the following subjects for the year 1914–15.

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Two in *Tropical Medicine*	Prof. F. M. Sandwith, M.D., F.R.C.P. Vacant.

The Examiners above named are re-eligible, and intend to offer themselves for re-election.

N.B.—Attention is drawn to the provision of Statute 124, whereby the Senate is required, if practicable, to appoint at least one Examiner who is not a Teacher of the University.

Candidates must send in their names to the Principal, with any attestation of their qualifications they may think desirable, on or before MONDAY, DECEMBER 15. (It is particularly desired by the Senate that no application of any kind be made to its individual Members.)

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University of London,
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HENRY A. MIERS,
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ROYAL ANTHROPOLOGICAL INSTITUTE.

Monsieur Fr. DE ZELTNER will deliver a Lecture on "The Tuareg," illustrated by lantern slides, on WEDNESDAY, NOVEMBER 26, at 5 p.m., at 50, GREAT RUSSELL STREET, W.C.

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THURSDAY, NOVEMBER 20, 1913.

MODERN PHYSICAL IDEAS AND RESEARCHES.

(1) *Modern Electrical Theory.* By Dr. N. R. Campbell. Second edition. Pp. xii + 400. (Cambridge: University Press, 1913.) Price 9s. net.

(2) *Les Idées Modernes sur la Constitution de la Matière. Conférences Faites en 1912.* By E. Bauer, A. Blanc, E. Bloch, Mme. P. Curie, A. Debierne, and others. Pp. 370. (Paris: Gauthier-Villars, 1913.) Price 12 francs.

(3) *Researches in Physical Optics, with especial reference to the Radiation of Electrons.* Part i. By Prof. R. W. Wood. Pp. vii + 134 + x plates. (New York: Columbia University Press, 1913.)

(1) THE second edition of Dr. Norman Campbell's "Modern Electrical Theory," reviewed first in NATURE, May 28, 1908, is practically a new book. The work of Barkla and Bragg, and the theories of Einstein and Planck have rendered necessary a fresh treatment of part ii., dealing with radiation. The principle of relativity and Stark's work on valency alter completely part iii., which deals with electricity and matter, a field in which second thoughts have proved notoriously less ambitious than the first, whilst the first part, which deals with the electron theory proper, has also been entirely re-written.

It must have been a task of no ordinary magnitude to attempt to present to-day the changing theories of modern physics. Speaking of the subject of radiation, the author claims it is the best attempt in the English language to deal generally with the matter, because "so far as I know there is no other." Again, in the references to the literature at the end of chapter i., after a mention of Lorentz's "Theory of Electrons," we read: "I know of no other English treatise which can be recommended with confidence," and the remark will be generally endorsed.

The book deals with the whole of the large legitimate field of the electron theory, electro-magnetism, metallic and electrolytic conduction, optics, radiation, and the chemical as well as physical properties of matter. It is in welcome contrast to the earlier more or less popular presentations of the subject which have appeared in our language, in that as much attention is given to the failures as to the successes of the theory, and in that, in the absence of any experimental evidence of positive electricity apart from matter, it does not trespass unduly into the region which many people have been led to regard as the chief object of the electron theory, the explanation of matter in terms of the electron.

Physical theories at the present moment are so shaky at the foundations that the doubt arises sometimes whether the superstructure is not being built up too rapidly. The difficulties, now ten years old, in reconciling the undulatory and corpuscular types of radiation in one theory, the hopeless confusion that prevails as to the necessity for the existence of an ether, and the modern discrete or quantum theory of energy, seem to call for a more drastic reconsideration than we find here of many of the simplest physical conceptions and their experimental basis. Take, for example, the view that has been universally held of the uniform propagation of radiation in all directions through space. There seems to be really no evidence for this. All that experiment and observation justify is its propagation between portions of space occupied by matter. Elsewhere it may not be propagated at all. Recent suggestions that it is propagated along "Faraday tubes" which, starting from the radiator, must necessarily end "somewhere," seem vaguely to imply something of the kind. But what a different complexion would be assumed by some of the larger generalisations of science, in the field, for example, of the maintenance of solar and cosmical energy, not to mention problems in wireless telegraphy connected with the curvature of the waves round the earth, and all of the topics dealt with in the present book, if it were frankly confessed at the outset that we are really in complete ignorance as to the answer to this simplest first question about the nature of radiation.

In the concluding chapters the author permits himself to wander beyond the strict boundary of his subject to discuss the principle of relativity and the changes in current ideas required from this new point of view. It is at least instructive to try to follow a British author attempting to reproduce these abstruse conceptions, which as yet scarcely anyone in this country professes to understand, or at least to appreciate. But the exposition is marred by too great an anxiety to defend the view from possible objections, and it cannot be said that the fundamental or primary significance of the principle is made out, or that it has been duly correlated with other physical conceptions. One remains in doubt whether, if not metaphysical, it is not of subjective rather than objective importance, a mathematical correction to render consistent observations in which the velocity of light enters, and which would be, if not actually false, at least inoperative were gravitational action, for example, instead of light employed to transmit the intelligence of an event to a distant place.

It may be true that it is impossible to conceive of a body moving relatively to an observer with velocity greater than that of light. But we can, and do, work with β-particles of radium, and we can imagine two of these expelled in opposite directions from a source of radium at rest relatively to the earth, and therefore, in ordinary parlance, having a velocity relatively to one another nearly twice that of light. This, of course, in no way questions or minimises the importance of the principle of the great German mathematical physicist in its own field, but science is ever sceptical of restrictions which it is told must necessarily and for all time limit its power of disentangling the phenomenon from the appearance of the phenomenon. In any case the author deserves success in thus including in this conscientious review of modern electrical theory some of the modern conceptions which are at once the most foreign to our habits of thought and the most difficult to appreciate at their true worth. Successful the volume undoubtedly is in its purpose of providing serious students acquainted with the older physics an introduction to the newer theories.

(2) This collection of ten lectures by as many authorities treats in simple and clear fashion with some of the special departments of physical science now most to the fore. Brownian movement, the subject of high vacua or ultra-rarefied gases, and the relations between matter and the ether are the only three topics which can claim even thirty years of history. Three more deal with the electron in one or other aspect—electro-magnetic dynamics, the electronic theory of metals, and ionisation by collision and the electric spark—and two with radioactivity, the radiations of the radioactive substances, and their successive transformations. Lastly, two of the newest conceptions, the quantum theory of energy and the magneton theory, complete the volume, which will prove as useful and interesting as earlier publications on similar lines by the Société française de Physique.

(3) The third volume is a collection of some of the most interesting and beautiful discoveries of Prof. R. W. Wood, issued by the Columbia University under the E. K. Adams fund for physical research. They include the notable contributions to resonance spectra and radiations, first with iodine, then from mercury vapour, which have enabled the vapour arising from a cold surface of mercury to be photographed, and going on to experiments with heat waves of more than 0·1 mm. wave-length, analogous to those with Herzian waves, in which a "dew" of condensed mercury globules deposited on quartz was employed for the resonator. This in turn leads to some extraordinary, still incomplete, observations on the electric conductivity of ruled silvered glass gratings, in spite of the complete severance of the silver film by the diamond.

Lastly must be mentioned some attempts to photograph the lunar surface through screens transmitting only yellow, violet, and ultra-violet light respectively. These photographs reveal the presence of a remarkable deposit round the crater of Aristarchus, which very probably may be sulphur, and foreshadow a method for carrying out a limited petrological survey of the lunar surface. It is a pity that the volume does not appear to be for sale, for many no doubt would be glad to secure this well-illustrated collection of modern experimental researches by one of its greatest masters.

FREDERICK SODDY.

THE THRESHOLD OF SCIENCE—AND BEYOND.

(1) *Zoology*. By Prof. E. Brucker. Pp. xiii + 219. (London: Constable and Co., Ltd., 1913.) Price 2s. net.

(2) *Some Secrets of Nature*. Short Studies in Field and Wood. With an introduction by W. J. P. Burton. Pp. xiv + 144 + plates. (London: Methuen and Co., Ltd., n.d.) Price 1s. 6d.

(3) *The Romance of Nature*. Studies of the Earth and its Life. With a preface by the Rev. A. Thornley. Pp. xix + 164 + x plates. (London: Methuen and Co., Ltd., n.d.) Price 2s.

(4) *In the Lap of the Lammermoors*. By W. McConachie. Pp. xii + 315. (Edinburgh and London: William Blackwood and Sons, 1913.) Price 5s. net.

(1) ONE of the many ways of beginning the study of zoology is to take a survey of the whole animal kingdom, working from the simple to the complex, never going very deeply into anything, but using now this, now that, to illustrate a principle. That is what Prof. Brucker has done, and it is a feat to have done it so clearly and in such simple language. If the reader, young or old, is able to touch and handle, as well as read about, even a tenth of the creatures discussed, he will have got far across the threshold of the science—to use the phrase which gives its name to this new series. To our thinking there is far too much in the book for an introduction, but that is largely a matter of opinion, and it is doubtless what students say of most courses of elementary instruction which their professors after much thought on the subject decide to deliver. Be this as it may, the author of this little book is evi-

dently an experienced teacher, and he has been successful in working out the method he has adopted. His avoidance of the unnecessarily technical is most praiseworthy, even if it leads to difficulties of its own, such as that one, more or less happily circumvented, that the squids are "molluscs with the foot surrounding the head." That is rather a stiff one on the threshold!

(2) A very different kind of introduction is supplied by "Some Secrets of Nature," a book showing real educational insight on the part of the anonymous author. Why should we not know who this is, who sets these quite admirable "problems for consideration," sometimes just a little conundrumoid, at the end of each short study; who reveals a very intimate knowledge of what really goes on in field and wood and some other places too; who knows how to awaken the scientific spirit? As a guide to the embarrassed teacher and an aid to the eager pupil, where rural nature-study (plants and animals) is concerned, we would very strongly recommend this book. We venture to suggest that the note *personnel*—natural in a talk—becomes a little fatiguing in this book. The author is no egotist, but he must have impoverished the printer's stock of one letter.

(3) "The Romance of Nature" is meant to be a "Nature Reader for Senior Scholars," but it is not, in our opinion, very successful. The first chapter discloses what the rest of the book confirms, that the writers are ignorant of the psychology of the normal senior scholar. From the earth's beginnings to the establishment of land and sea; the story of rock and fossil; the life-cycle of a plant and the life-history of a frog; birds and insects; and so on—the general idea and intention of the book is good enough, but the outcome seems to us unattractive. The writers know a great deal; their book is full of useful information; the outlook is wholesome; the inculcation of reverence and independent research is admirable: yet, somehow, this "Nature Reader" does not grip, and we are afraid that it will not lead many senior scholars to appreciate the "Romance of Nature." For one thing, the style is not good enough.

(4) It is not quite fair to bring in Mr. McConachie's book along with the foregoing, for it is a work of art. They are helps across the threshold, but he has got to the hearthstone. Yet there may be justification for what we have had to do. For while the first three books follow different methods, is not their aim one—that of seeing, understanding, enjoying, and learning from what we call Nature? And it is our conviction that unless "Nature Study"—helped or hindered by books—makes for, or at least towards, that cultured outlook which Mr. McConachie's past and present work reveals, then it has in great part missed its mark. The first book reminds us that we must see widely and at the same time precisely; the second book rouses the curious questioning spirit; the third book suggests reverence before the wonderfulness of things; in the fourth book we have the harvest of a clear, searching, well-informed, and loving eye.

Mr. McConachie tells us of his walks in a Border parish, but his gift to us is independent of geography—the suggestion of how much there is in that which lies closest to our feet. Of course, he could not do what he does in these sketches—to be ranked beside those of Richard Jefferies and John Burroughs—unless he knew his birds and flowers and more besides really well, and unless he had a rare gift of style. But beyond that, in these pictures of the Border Parish, the Golden Glen, the Drifting Mist, the Woodpecker's Nest, the Wilderness, the Meadow Burn, the Lonesome Moor, the Summer Shielings, the Southward Flight—to name just a few—there is "a feeling for Nature," which, while in part doubtless the gift of the gods, is also the reward of those who sojourn with nature in sunshine and in storm, and who discipline themselves to hear her voices. And this is the chief end of "Nature-study."

J. Arthur Thomson.

PRACTICAL MATHEMATICS.

(1) *Practical Mathematics: First Year.* By A. E. Young. Pp. vii+124. (London: George Routledge and Sons, Ltd., 1913.) Price 1s. 6d. net.

(2) *An Elementary Treatise on Calculus.* A Textbook for Colleges and Technical Schools. By W. S. Franklin, B. MacNutt, and R. L. Charles. Pp. ix+253+41. (South Bethlehem, Pa: Lehigh University, 1913.) Price $2.00.

(3) *Problèmes de Mécanique et cours de Cinématique.* By Prof. C. Guichard. Rédaction de MM. Dautry et Deschamps. Pp. 156. (Paris: A. Herman et Fils, 1913.) Price 6 francs.

(4) *Further Problems in the Theory and Design of Structures.* By E. S. Andrews. Pp. viii+236. (London: Chapman and Hall, Ltd., 1913.) Price 7s. 6d. net.

(1) THE author has covered a wide range of topics within the small compass of a hundred pages. He opens by explaining the use of the vernier calliper and the micrometer screw-gauge, and this leads naturally to an exposition of contracted methods. There is an excellent chapter on graphical work, which includes applications to statics; and there are also sections on the

practical use of logarithms, the meaning of the trigonometric functions, the mensuration of plane and solid figures, and variation. The concluding chapter introduces the reader to Cartesian geometry.

(2) The lines on which this text-book is written show that the authors are convinced, and in our opinion rightly, that a knowledge of the ideas and methods of the calculus can be obtained without any severe algebraic manipulation. They have wisely omitted all purely formal developments of the subject, and have introduced integration at an early stage. The explanations are given in a clear and simple style, and a variety of applications are made which should secure the interest of the reader. In a work such as this a rigorous treatment is out of place, but it is well to warn the student of this, and we disagree with the authors in their suggestion that the proof given of Maclaurin's theorem is complete, and secure against criticism. The subject-matter includes ordinary and partial differential equations and an excellent account of vector analysis. It is curious and regrettable that this is generally omitted by English writers.

(3) The first half of this volume is occupied with the solution of rather a miscellaneous set of problems on the motion of plane and solid bodies and systems of bodies, with special reference to envelopes and roulettes. The remainder falls into three sections: (1) particle dynamics; (2) rigid dynamics; (3) a brief account of relative motion, and the composition of motions of translation and rotation. Each of these is taken in far less detail than would be the case in a similar English treatise, and no exercises are included. Many students, however, might profitably read a course of this kind to supplement their ordinary text-book.

(4) This is a sequel to the author's former work on structures, forming a supplementary volume dealing with recent developments of the subject. The first eighty pages give a clear and full account of the method of influence lines, which, although suggested in Germany forty years ago, has until quite recently received little attention in this country. The next sixty pages deal with the principle of work and its application to the deflection of framed structures, redundant frames, and rigid or elastic arches; and the remainder to portals, wind bracings, and secondary stresses.

The mathematical work is set out at full length, and so clearly that it should offer few difficulties. The diagrams are excellent; and the problems chosen for discussion are of real practical interest; their selection and treatment is evidently the work of a thoroughly experienced teacher.

LABORATORY EXPERIMENTS IN AERONAUTICS.

The Resistance of the Air and Aviation. Experiments conducted at the Champ de Mars Laboratory. By G. Eiffel. Second edition, revised and enlarged. Translated by J. C. Hunsaker. Pp. xvi + 242 + xxvii plates. (London: Constable and Co., Ltd.; Boston and New York: Houghton Mifflin Co., 1913.) Price 42s. net.

AN English edition of this work will be welcomed by the large and increasing circle of scientific and engineering men who are desirous of obtaining accurate experimental data in aeronautics from which to direct their work. It need not be said that the experimental work of M. Eiffel repays study, for whether the reader seeks to gain information regarding the difficult and perplexing problems met with in this branch of physics, or practical "tips" for designing aerofoils, he will not be disappointed. Though the contents of this book, based as they are upon experiments made at the laboratory at the Champ de Mars, have passed into the category of established experimental facts, they are not so well known as they deserve to be.

The great new Auteuil laboratory[1] is described in the volume, from which in the future we may expect great things; nevertheless, the results obtained at the Champ de Mars with the smaller wind tunnel to which the volume before us is devoted, will pass the most critical examination for painstaking experimental work. From time to time we are met with suggestions that capable mathematicians should be entrusted with problems of stability and like questions, but the mathematical investigator must be provided with carefully ascertained facts if his conclusions are to be worth anything at all.

From such experiments as these, and from those made at the National Physical Laboratory, the mathematician must derive the grain for his logical mill. That good use will be made of them there cannot be any reason to doubt. As aeroplane wing sections are capable of indefinite variation, and no two experimenters have adopted similar sections, comparison of the work of different experimenters becomes difficult, hence the conflicting results which are quoted by those who have not taken into account the many independent variables entering into the experiments.

Perhaps the most striking result in this series of experiments on aeroplane wings is the effect of the "negative" angle at the leading edge as increasing the efficiency. After considering the

[1] See NATURE, February 20, 1913, p. 677, *et seq.*

results on the eighteen types of wing which formed the models experimented on, there is no special type which can be said to be the most advantageous from the aeroplane constructor's point of view, and the choice of the most advantageous depends upon the conditions of the particular problem in each case. In the case of wings with reverse curvature it was found that the reaction was no longer proportional to the square of the velocities. The wings tested had sections similar to those employed by the principal designers of aeroplanes.

Propellers were tested by driving them by an electric motor in the wind tunnel; thus the results obtained more closely conform to the conditions of flight, and the "dynamic" instead of the "static" thrust is obtained. The conclusions to be drawn from the experiments are that the reaction upon a propeller cannot be assumed exactly proportional to the square of the relative velocity, and from a study of the model it is possible to predict all the elements of propeller action provided that the model be tested with the same relative velocity, both in magnitude and direction, that the full-sized propeller is expected to use. This requires for the same velocity of translation a speed of rotation inversely proportional to the diameters of model and propeller. The distortion of the propeller at high velocities is mentioned as a cause of some variations observed in the results. Velocities of 5 to 18 metres per second were used, and the propellers were driven at speeds from 400 to 1600 revolutions per minute.

By such experiments facts are being brought to light which already have had a great influence on aeroplane construction in France, and the experiments on models offer a safe guide to the behaviour of the air upon aeroplane wings by the use of appropriate constants. From the results of the experiments the minimum effective power that can sustain flight is obtained for a given wing section. Thus a Blériot machine with a supporting area of 25 sq. metres, weight in service with pilot 588 kg., and an angle of attack of 9°, was found by the model to require a minimum effective power of 24 h.p. This, it is stated, is practically the power used. The effect of superposed planes is also studied; also the effect of aspect ratio upon the reaction. In this connection it may be mentioned that the author first observed the curious variations for a square plate with the Eiffel Tower dropping apparatus. The reaction on a square plate inclined 37° is nearly one and one-half times the reaction when normal to the wind. With good judgment the translator has retained the metric units.

R. S. B.

OUR BOOKSHELF.

Ulster Folklore. By Elizabeth Andrews. Pp. xiii + 121 + xii plates. (London: Elliot Stock, 1913.) Price 5*s*. net.

This dainty volume is made up of a collection of papers communicated to various societies and journals. As much of the information was collected at first hand, the book is a valuable contribution to the literature of Irish folklore. The expressed purpose kept in view was to find, and show, some correspondence between the description of Irish fairies and that of actual pigmies found, dead and alive, in various parts of the world, and that purpose gives unity to the work, which is more of a monograph than a folklore drag-net. The correspondence made out is certainly very striking. There are also rare pigmies to be met with in Ireland as well as elsewhere. But of the actual existence of pigmy communities in Ireland no evidence is given. The fairies there, as elsewhere, haunt "raths and souterrains." They occupy Neolithic megalithic structures. The photographs, plans, and descriptions of some fairy souterrains give the work special value. One recognises the invariably oriented creepway. Only on one plan the north point is marked, that of Knockdhu (p. 30). If the true north is given, the cove, which is 87 ft. long, is oriented 70° N.W.–S.E. The entrance is south-east; and assuming a sky-line elevation of one degree, the star Antares is indicated about 1700 B.C., a date by no means late for a Neolithic culture in the north of Ireland.

There is some evidence to show "that Palæolithic man lived and worked in Ireland" (pp. 99–100). "It is difficult to exterminate a people, and they could not be driven further west" (p. 104). One may add that the pigmy of folklore is much more ancient than the Irish Neolithic men. In the case of Ireland, however, what may be said with tolerable certainty is that the fairies are the Neolithic builders, and the case is well stated in a quoted statement of the late Mr. John Gray. "The stature of these primitive Danes and Pechts is five feet three inches, and they must have looked very small men to the later Teutonic invaders of an average stature of five feet eight and a half inches" (p. 102). The souterrains of Ardtole and Maghera are 5 ft. 3 in. high.

John Griffith.

Chemistry: Inorganic and Organic, with Experiments. By C. L. Bloxam. Tenth edition, Rewritten and Revised by A. G. Bloxam and Dr. S. J. Lewis. Pp. xii + 878. (London. J. and A. Churchill, 1913.) Price 21*s*. net.

The first edition of this well-known treatise appeared in 1867, and consisted of 630 pages which, as the preface of the present issue points out, sufficed to give a fuller account of the science of chemistry than the tenth edition can pretend to offer. The development of physical chemistry has rendered necessary a recasting of the first portion of the book. The periodic classification is followed more closely than in previous editions, and the inorganic portion of the volume rather than the organic has been developed in accordance with the increased attention which, the editors say, has been directed to inorganic chemistry of late years. Precise details from original memoirs, outside the scope of the ordinary text-book, have been included and will increase the value of the work for more advanced students.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Distance of the Visible Horizon.

THE subject of terrestrial refraction and its effect on the distance of the visible horizon, about which Mr. Backhouse inquires in NATURE of September 25, is very fully discussed in the second volume of Jordan's "Handbuch der Vermessungskunde." The formula there proved is

$$a = \sqrt{\frac{2r}{1-k}h}$$

where a = distance of visible horizon.
r = earth's radius.
k = coefficient of refraction (mean value 0·13).
h = height of observer.

This formula reduces to

Distance in statute miles $= 1{\cdot}312\sqrt{\text{height in feet}}$.

The subject is also discussed in Gillespie's "Higher Surveying," where, using a slightly different coefficient of refraction, the formula arrived at is very nearly the same, viz. :—

Distance in statute miles $= 1{\cdot}317\sqrt{\text{height in feet}}$.

It is easy to construct a table from either of these formulæ which will give the distance of the visible horizon at any height under average atmospheric conditions.

The method of reducing trigonometric heights described by Capt. Tizard, where the refraction-angle is taken at 5″ for each nautical mile of distance, is equivalent to using a refraction-coefficient of 0·18 in place of Jordan's 0·13. My own experience in the Red Sea and Gulf of Suez is that Jordan's value is tolerably correct near midday in winter and spring; this would imply that 4″ per nautical mile of distance is a nearer value than Capt. Tizard's 5″ under those conditions, and as a matter of fact the substitution of the lesser value leads to a rather better agreement for the height of Jebel Hooswah than that shown in Capt. Tizard's table.

Abnormalities of refraction, such as Capt. Tizard notes, are tolerably frequent over tropical seas, and one naturally avoids making measurements of altitude when the conditions are palpably abnormal. The variation of 18° in the altitude of the horizon in the Arctic regions, quoted by Capt. Tizard, is doubtless a misprint for 18′ or 18″; but in any case such a figure is meaningless unless the height of the observation-point is given.

It is not temperature *per se* which affects refraction, so much as the vertical temperature-gradient in the air; this varies very rapidly in the early morning hours, but becomes more steady about noon. I have found that at fair altitudes the refraction is in general wonderfully constant in the middle of the day, say between 11.30 a.m. and 3 p.m.; and by restricting observations for level to this time of the day I have obtained very much more concordant results than those quoted by Capt. Tizard. If the object is only visible in the early morning or late evening, an evening observation is much to be preferred to a morning one.

The table given by Capt. Tizard is liable to give an exaggerated impression of the range of refraction. The differences of height found for the same point by his various observations probably depend not so much on variations in refraction, as on the roughness of the angular observations; in all cases except two, his depression-angles are only given to minutes, and a minute of arc at a distance of fifty-eight nautical miles subtends more than 100 ft. It is easy nowadays to measure the vertical angles well within 5″ of the truth, using only a 6-in. micrometer-theodolite; but perhaps in 1871 the instruments available were of a less accurate nature, and one must not be too critical of the results obtained. I would, however, venture to point out that it is incorrect to take the arithmetic mean of the heights from a number of observations at different distances when the least certain factor in the height (the correction to the height due to refraction) varies as the square of the distance; and it is scarcely scientific to correct for refraction to single seconds when the observations themselves are only taken to the nearest minute, or to calculate heights to four significant figures from distances given only to three.

JOHN BALL.
Survey Department, Cairo, October 2.

WITH reference to the remarks of Dr. John Ball, I am much obliged to him for directing my attention to Jordan's "Handbuch der Vermessungskunde" and Gillespie's "Higher Surveying," two works with which I was previously unacquainted.

The coefficient for refraction given by Jordan is the mean of a number of results by different observers in different countries, the originals varying from 0·105 to 0·167.

These results show that the refraction is a very variable quantity, and that the results inland are different from those near the sea. In Gillespie's work he shows how the refraction varies at different hours in the day on the coast of California (*a*) from a height of 57 metres, and (*b*) from a height of 1173 metres, being least near noon, and greatest in the morning and evening. From the height of 57 metres the coefficient varied from 0·14 to 0·10, whilst from the height of 1173 metres it varied from 0·09 to 0·06.

Gillespie publishes curves showing the results obtained. But he points out that the refraction is a very variable quantity, and it is doubtful whether the same curves would be obtained at all seasons at the same place. These are the very observations that are required.

It is quite true, as Dr. Ball points out, that if at Jebel Hooswah a refraction of 4 seconds instead of 5 per mile was used the results would be in closer accordance, but he does not appear to have seen that if a refraction of 6 seconds instead of 5 per mile was used for the Jebel Serbal observations they would be still more in accordance with each other. Therefore on different days and from different heights the results in the one case would be closer if the coefficient for refraction was decreased, and in the other if it was increased. Abnormal refractions are more common in high than in low latitudes; the greatest I have seen personally was in the Baltic Sea.

With reference to Dr. Ball's observations on the table given by me I reply as follows :—

(1) The observations were obtained by a 5-in. theodolite reading to 30″ of arc.

(2) That the results given from angles of depression from Jebel Serbal to points nearly 180° apart show (*a*) that the theodolite was in perfect adjustment, and that the height obtained from a distance of fifty-eight miles on the north side differed only 116 ft. from the height obtained at a distance of 24·9 miles on the south side.

(3) Although observations obtained with imperfect instruments—and what instrument is perfect?—may give results not perfectly accurate, I cannot admit that the corrections applied should not be as accurate as they can be.

(4) Dr. Ball is correct in stating that a distance of fifty-eight miles an error of one minute in the angle of depression means a difference of about 100 ft. in the result.

(5) He is also correct in his surmise that the variation in altitude of the horizon in the Arctic should be 18 minutes and not 18 degrees. This is a printer's error.

T. H. TIZARD.

The Piltdown Skull and Brain Cast.

THE excellent figure of the Piltdown brain cast which accompanied Prof. Elliot Smith's last letter (NATURE, November 13, p. 318) brings out clearly the differences which separate him and me. His figure represents a brain with approximately symmetrical right and left hemispheres, so far as these are viewed from the hinder or occipital aspect. If, then, the anatomical parts occupy corresponding positions on the two sides, he has solved the problem of how to reconstruct the Piltdown skull so as to obtain a considerably smaller brain than I had postulated. I have made a tracing of his reconstruction in order to fill in with some details the exact relationship of parts represented by his drawing. It will be seen he has obtained symmetry by the most simple means. In the original brain cast the right hemisphere of the brain measured only 555 cubic centimetres, the left half 645 c.c.; this difference of 90 c.c. referred only to the hinder part of each hemisphere. In Prof. Elliot Smith's reconstruction the hemispheres have been balanced by moving the left hemisphere towards or beyond the middle line and enlarging the left hemisphere. The middle line which Prof. Elliot Smith has selected is exactly that used by Dr. Smith Woodward in the reconstruction of the skull, not that which he employed when building up the brain cast; in building up the brain he employed another middle-line altogether.

In the accompanying tracing of Prof. Elliot Smith's reconstruction I have indicated the longitudinal blood sinus which sweeps widely (10 mm.) to the right as it passes between the occipital poles of the brain. The left pole exceeds the right to a degree which is seldom seen in even the highest forms of modern human brains. Seven years ago Prof. Elliot Smith published a short paper (*Anat. Anz.*, 1907, vol. xxx., p. 574), which is justly regarded as authoritative. He directed attention to the preponderance of the left occipital pole of the brain, and attributed that preponderance to the specialisation of the right hand; only the slightest degree of asymmetry is observable in anthropoid apes. Indeed, at that time Prof. Elliot Smith definitely stated that he regarded symmetry of the occipital poles—in my opinion an absolutely just deduction—as a simian character. He will, therefore, if he retains the present reconstruction, have to modify to some extent the opinion he has expressed of the brain of Piltdown man—that it is "the most primitive and simian brain yet recorded." As regards the asymmetry of the occipital poles, it is, in my opinion, ultra-modern.

Prof. Elliot Smith has frankly stated that his reconstruction is not, in the strict sense of the word, a cranial cast—a cast taken from the interior of a reconstructed skull; it is a reconstruction built up—as the original brain cast must have been—from impressions taken from the inner or cerebral aspect of the cranial bones. To test such a brain reconstruction

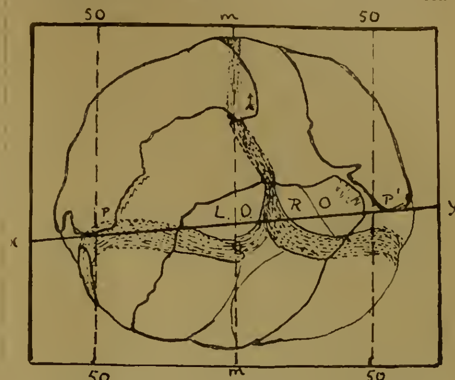

FIG. 1.—Tracing of Prof. Elliot Smith's reconstruction of the brain-cast with certain additions. (Half nat. size.)

the actual fragments of the skull must be placed over the corresponding parts of the brain cast. When that is done it is at once seen that in securing a symmetry of the brain hemispheres the corresponding parts of the skull are thrown somewhat out of position. On the tracing of the reconstruction (Fig. 1) I have drawn a line, *x*—*y*, across corresponding angles of the parietal bones. That of the right side is a centimetre higher than on the left; on the right side the lamb-

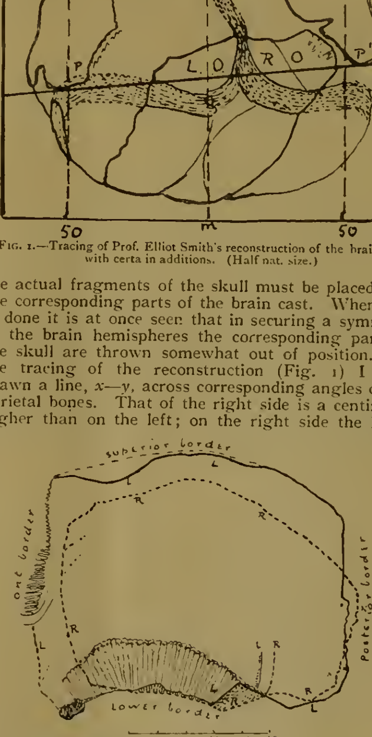

FIG. 2.—Tracing of the right fragment of the parietal (Piltdown) fragment (broken line) superimposed on the right bone (continuous line). (Half nat. size.)

doid suture passes outside the 50 mm. vertical line; on the left it stops short of that line.

It may be questioned if the hinder, lower angle of the parietal bones do correspond. That was the very first point I set out to determine when I found there was such a discrepancy between the size of the Piltdown cranial fragments and the brain capacity which Dr. Smith Woodward had ascribed to this earliest known form of man. That is the first step which has to be taken. In Fig. 2

I give drawings representing the corresponding parts of these two bones. The determination is not difficult; in each bone, enough of the lower border is preserved to guide one with certainty to the identification of right and left parts. In both sides the lower hinder angle of the parietal bone is broken away, but although not fractured in exactly the same manner, the lowest point in both cases may be taken as in strict correspondence. In this reconstruction then the lower border of the right parietal occupies a position nearly half an inch higher on the right than on the left side. I think that discrepancy must be due to an error in reconstruction.

I have not entered into a discussion on the markings which indicate the middle line of the skull for this reason. A very considerable experience in attempting to reconstruct ancient and modern skulls from fragments has convinced me that if a wrong bearing is taken—if one misidentifies any point in the middle line—unless it be a very slight error, that misidentification will find the reconstructor out, and his task will be brought to a halt by the development of a degree of asymmetry. If, on the other hand, points are rightly recognised—often it has to be by repeated experiment—then the parts fit easily together, provided there is a sufficiency of them, and in the case of Piltdown there is an ample sufficiency. I look upon the problem of rightly reconstructing a skull as similar to that of replacing the fragments of a broken vase of symmetrical design. Given the fragments of the greater part of one half and a part of the other, there cannot be two reconstructions. All the parts may be got together except one fragment. The remaining fragment is evidence that the task has not been accomplished. I know very well that my friend Prof. Elliot Smith is searching for a true representation of the brain-state of the very earliest human form that can claim any direct relationship to modern men; I hope I may claim the same spirit for myself. I also admit that he has gone a considerable way towards what, in my opinion, must have been the original form. The points on which we disagree are now apparent, and I am content, having had an opportunity of presenting my case, to leave the final decision to the future.

Arthur Keith.

Royal College of Surgeons, W.C.

Work of Natural Forces in Relation to Time.

In the notice of the "Origin and Antiquity of Man" (Nature, October 9), the remark that I have "returned to the manner of thinking which was prevalent before the days of Lyell" calls for some comment. It would be nearer correct to say that I have adopted the manner of thinking occasioned by the facts which have come to light since Lyell's day, and which may be succinctly described as that of regarding nature, not as a "uniformity," but an "evolution." Lyell's habit of regarding nature as a progression by infinitesimal steps has been corrected by later observations which reveal, at times certainly, a much more rapid rate of progress than he and his followers have been wont to admit. Lyell certainly failed to appreciate the activity even of the present forces of nature.

For example, in 1842, after a cursory examination of Niagara Falls, he put forth the estimate that their recession could not have amounted to more than one foot a year, and probably one foot in three years, thus making the age of the cataract at least 35,000 years, and probably 100,000. But at his suggestion Dr. John Hall made a trigonometrical survey of the front of the falls and set up monuments so that the rate could be eventually determined by actual measurements. After seventy years, surveys show that the falls have receded, during the entire period, at a rate of about five feet a year.

Again, Darwin, adopting Sir Charles Lyell's methods in the first edition of his "Origin of Species," estimated that the erosion of the Wealden deposits in England required the work of 306,662,400 years, which he called "a mere trifle of geological time." But on having his attention directed to the activity of subaërial erosive agencies acting over the entire surface at all times, concerning which a great mass of evidence had recently been gathered, he confessed in a second edition that he had made a rash statement, and in subsequent editions withdrew it entirely. The facts accumulated concerning the activity of present eroding forces show that instead of the immense period originally assumed by Darwin, the whole removal of the Wealden strata would be accomplished in a few million years.

But it is in respect to the rapidity of glacial movements that the slow rates assumed by Lyell and his followers are pre-eminently misleading. Those whose studies of glaciers have been limited mainly to the Alps, have not readily appreciated the facts concerning the movement of glaciers in North America. For example, it was in 1886 that I made the first extended observations upon the great Muir Glacier in Alaska. This glacier presented a water front one mile in width, rising 300 ft. above the water, and descending 700 ft. below the water. From examination of various lines of evidence I was able to show that, when Vancouver surveyed the region 100 years before, the Muir Glacier with various others coming in to Glacier Bay had united to project the ice twenty miles farther south, with a thickness of two or three thousand feet. The correctness of this inference has been abundantly corroborated by subsequent observers.

But now comes the confirmatory evidence in the fact that the Muir Glacier has receded seven miles and a half in the twenty-five years that have elapsed since my first observations. Moreover, the ablation from the surface has been such as to lower it 700 ft. In short, we have here from actual observation in a glacial field larger than that of the Alps, evidence of greater changes in twenty-five years than some of those for which Prof. Penck has demanded many thousand years.

The word uniformity as applied to the action of natural forces, both in geology and biology, is unfortunate and misleading. There is, indeed, continuity. But this permits varying rates of movement according to evolutionary laws, so that, as Huxley observed, all that Darwin had to do to adjust his theory to the recent moderate estimates of geological time was to assume a more rapid rate of variation. Neither need the Darwinian be afraid of recognising paroxysms in nature, since they naturally follow the slow accumulations of strain which finally culminate in some sort of fracture or interruption of the ordinary course of events. I am not a pre-Lyellian, but a post-Lyellian.

G. Frederick Wright.

Oberlin, Ohio, October 23.

The United States Territory of Hawaii.

Dr. J. Stanley Gardiner, in his appreciative notice of "Fauna Hawaiiensis," in Nature of September 25, just received, has used a name against which I must enter protest. I thought it a possible misprint, but it appears several times as Hawaiia.

We shall probably have to bear Cook's name, Sandwich Islands, from our conservative English friends for some years longer, although the Hawaiian kingdom was independent many years, and never officially used that name, although having diplomatic and commercial agents in England as elsewhere. Its successor, the United States territory of Hawaii, now administers the affairs of the late kingdom. Neither kingdom nor republican territory has ever sanctioned such a barbarous name as your reviewer gives—Hawaiia.

WM. T. BRIGHAM.

Bernice Pauahi Bishop Museum, Honolulu, H.I., October 24.

THE first article in the "Fauna Hawaiiensis" is entitled "Introduction, being a Review of the Land-Fauna of Hawaiia." Dr. Brigham's quarrel is hence with the writer of that article, and with the editor of the fauna, not with me. I should have expected "Hawaiia" to meet with his approval as against the rather cumbrous title, "United States Territory of Hawaii," a title taken from the name of the largest island. The islands from Niihau to Hawaii stand on an isolated plateau in the ocean, and represent a geographical group; the name "Hawaiia," I consider, may quite usefully be applied to them. A name will also have to be adopted for the islands between Nihoa and Lisiansky, which form a similar group; these I frequently find in maps included in the Hawaiian Islands.

Presumably the aboriginal inhabitants had no name for the islands in question, as they knew no other lands, and certainly the Spanish navigators established no name for them. Cook's name, "Sandwich Islands," dates from 1778, and clearly has priority, a fact which should appeal to American—I hope Dr. Brigham will pardon this incorrect adjective being applied to his countrymen—biologists.

J. STANLEY GARDINER.

November 14.

INTERNATIONAL CONFERENCE ON THE STRUCTURE OF MATTER.

THE first International Conference in Brussels on the Theory of Radiation in 1911 (see NATURE, vol. lxxxviii., p. 82) owed its inception to Mr. Ernest Solvay, and proved a great success. Shortly afterwards, Mr. Solvay generously gave the sum of one million francs to form an International Physical Institute (NATURE, vol. xc., p. 545), part of the proceeds to be devoted to assistance of researches in physics and chemistry, and part to defray the expenditure of an occasional scientific conference between men of all nations to discuss scientific problems of special interest. In pursuance of this aim the second International Conference or Conseil International de Physique Solvay, was held in Brussels this year on October 27–31, under the able presidency of Prof. Lorentz. On this occasion the general subjects of discussion were confined to the structure of the atom, the structure of crystals, and the molecular theory of solid bodies.

Reports were presented by the following:—The structure of the atom, Sir J. J. Thomson; Intereferenzerscheinungen an Röntgenstrahlen hervorgerufen durch das Raumgitter der Kristalle, Prof. Laue; the relation between crystalline structure and chemical constitution, W. Barlow and Prof. Pope; some considerations on the structure of crystals, Prof. Brillouin; and Molekulartheorie der Festen Korper, Prof. Gruneisen.

Among those present at the meeting were Prof. Lorentz, Kamerlingh Onnes, Sir J. J. Thomson, Barlow, Pope, Jeans, Bragg, Rutherford, Mme. Curie, Gouy, Brillouin, Langevin, Voigt, Warburg, Nernst, Rubens, Wien, Einstein, Laue, Sommerfeld, Gruneisen, Weiss, Knudsen, Hasenöhrl, Wood, Goldschmidt, Verschaffelt, Lindemann, and De Broglie.

An interesting and vigorous discussion followed on all the papers presented to the congress. Special interest was taken in the report of Laue on the interference phenomena observed in crystals with x-rays. A valuable contribution was made by Prof. Bragg on selective reflection of x-rays by crystals, and on the information afforded by this new method of research on crystalline structure. The report of Mr. Barlow and Prof. Pope on the relation between crystalline structure and chemical constitution was illustrated by a number of models, and was followed with much interest. A report on the papers and discussions at the Conference will be published as promptly as possible.

The arrangements for the meeting, which was successful in every way, were admirably made by Dr. Goldschmidt. All the members stayed at the same hotel, and thus were afforded the best of opportunities for social intercourse and for the interchange of views on scientific questions. During the meeting, the members were very hospitably entertained by Mr. Solvay and Dr. Goldschmidt, while a visit was made to the splendid private wireless station of the latter, which is one of the largest in the world, capable of transmitting messages to the Congo and Burmah.

The committee of the International Physical Institute, who were present at the conference, held meetings to consider the applications for grants in aid of research, made possible by the sum set aside for this purpose by Mr. Solvay at the foundation of the institute.

It was arranged that the next meeting of the Conseil de Physique should be held in three years' time at Brussels, when there will be a new programme of subjects for discussion. In order to extend the scope of the congress, and to make it as representative as possible, it has been arranged that the original members will retire automatically at intervals, while their place will be taken by new members, who will be specially invited to take part in discussion of definite scientific topics.

E. RUTHERFORD.

ALFRED RUSSEL WALLACE.

THE last link with the great evolutionary writers of the mid-nineteenth century—the men who transformed the thought of the world—is broken. How can I best speak of the long, happy, hard-working, many-sided life that has just come to a close? The history of Wallace's contributions to science and the details of his career have been long known, and are now re-written and epitomised in the Press of the world. I propose to speak of the man himself as he was revealed to his friends.

I first saw Wallace about twenty-five years ago, introduced by a dear common friend and fellow-worker at the problems of evolution. We were on a short walking-tour, and our road lay through Godalming, where Wallace was then living. From that time I have been happy in his friendship and his kind encouragement and help.

Wallace possessed, like Charles Darwin, a charming personality. He was tall, with a magnificent head, a strong, clear, and pleasant voice, a hearty laugh, a keen sense of humour, an intense and vivid interest in the most varied subjects. But the central secret of his personal magnetism lay in his wide and unselfish sympathy.

It might be thought by those who did not know Wallace that the noble generosity which will always stand as an example before the world was something special—called forth by the illustrious man with whom he was brought into contact. This would be a great mistake. Wallace's attitude was characteristic, and remained characteristic to the end of his life.

A keen young naturalist in the north of England, taking part in an excursion to the New Forest, had called on Wallace and confided to him the dream of his life—a first-hand knowledge of tropical nature. When I visited Old Orchard in the summer of 1903, I found that Wallace was intently interested in two things: his garden, and the means by which his young friend's dream might best be realised. He then, and later on in many a letter, eagerly discussed the most favourable localities, the scientific memoirs to be carried, the means by which the journey could be undertaken, the disposal of collections, and every circumstance that would be likely to affect the success of the expedition. The subject was referred to in seventeen letters to the present writer: it formed the sole topic of some of them. It was a grand and inspiring thing to see this great man identifying himself heart and soul with the interests of one—till then a stranger—in whom he recognised the passionate longings of his own youth. By the force of sympathy he re-lived in the life of another the splendid years of early manhood.

In 1889, when the degree of D.C.L. was conferred upon him, Wallace stayed with us, and I was anxious to show him something of Oxford; but, with all that there is to be seen, one subject alone absorbed the whole of his interest. He was intensely anxious to find the rooms where Grant Allen had lived. He had received from Grant Allen's father a manuscript poem giving a picture of the ancient city dimly seen at midnight from an undergraduate's rooms. With the help of Grant Allen's college friends we were able to visit every house in which he had lived, but were forced to conclude that the poem was written in the rooms of a friend or from an imaginary point of view.

Of Wallace's energy and love of work much might be written. About ten years ago, at the age of eighty, he moved from Parkstone to Old Orchard, Broadstone, having himself superintended the building of the house and the laying out of the garden. In a letter written May 31, 1903, he speaks of "the charming 'lodge in the wilderness' I have got here in which to end my days on earth. I assure you I am enjoying it, perhaps more than I should ever have done at an earlier period." How entirely this happy anticipation was fulfilled is well shown by the following words written March 13, 1911, when Wallace was more than eighty-eight:—

> But what I am mainly at work (or at *play*) upon now is my garden, and I have suddenly developed a sad *mania* for Alpine plants, more especially for my old favourites, the genus Primula, which has received such wonderful additions lately from the Himalayas, but more particularly from N. China. My resuscitated hobby is due to my having now, the very *first* time in my life, a bit of ground really *suitable* for them, combining *shelter*, good aspects, a moist (even *boggy* in parts) subsoil, a moister atmosphere, and a good and varied soil. The new Primulas introduced by Veitch, Bees, and several others are so grand and charming that I have raised some from seed, and have applied for others (and for Alpines generally) to Kew, Edinburgh, Cambridge, and Dublin Botanical Gardens, and have already got such a fine lot of plants—about 20 species of Primulas and 150 of Alpines generally—with promises of more, that I am laying out a regular Alpine and bog garden, on a quite small scale, buying stone and stone chippings by the ton or truck-load, collecting sand and road scrapings, protecting against rabbits, &c., which all give me very interesting occupation, so filling up my time and powers of work that I have little time or energy for reading anything but newspapers, novels, and the regular supply of scientific or political periodicals.

And Wallace invoked for his friends the power which brought youth and happiness to his old age. "Many happy returns (and lots of work)," were his birthday wishes to the writer in 1909.

With the love of work we must above all associate the enthusiasm which Wallace put into all that he did—the bright, boyish spirit which shone in him as it did in Darwin. "I've enjoyed every minute of the time. Why, he has the spirit of a boy of eighteen!" was my daughter's comment on an afternoon spent at Old Orchard in the autumn of 1906. No youth gazing for the first time on the wonders of nature in the tropics could feel more enthusiasm than is expressed in Wallace's words describing a visit to the Natural History Museum on the morning after his Friday evening lecture at the Royal Institution in January, 1909:—

> I had a delightful two hours at the museum on Saturday morning, as Mr. Rothschild brought from Tring several of his glass-bottomed drawers with his finest New Guinea butterflies. They *were* a treat! I never saw anything more lovely and interesting!

The history of that Friday evening lecture—Wallace's last appearance before the scientific public—is given in the following passage, which is of interest in many ways, and recalls especially the famous 1858 essay—thought out in two hours and completed in three evenings. When the promise to the Royal Institution was made known, I addressed a friendly remonstrance to Wallace for having refused to lecture in Oxford. He replied November 6, 1908:—

I am a believer in *inspiration*. All my best ideas have come to me *suddenly*. I had quite determined to decline *this* one [invitation] when, lying on my couch, an *idea* suddenly came to me! I saw that the subject had *never* been treated from *that* point of view—I felt that I *could* and should *like* so to treat it, and that it would suit the audience and *do good*. So I accepted. I hope I shall be able to do it justice.

The late Aubrey Moore, in a remarkable address delivered thirty years ago to the Church Congress in Reading—an address noticed in the columns of Nature—spoke with disparagement of a mind "built like a modern ironclad in watertight compartments." But the criticism does not apply when the sliding doors are kept in good working order by constant use.

Wallace was keenly interested in many subjects—psychical, political, and economic—that would not attract the majority of the readers of Nature. With those who met him in the field of biological and especially of evolutionary inquiry, the whole of the intercourse was filled to overflowing with the give-and-take of friendly discussion. The opportunities that came all too rarely would have been wasted in argument over fundamental differences or in the vain attempt to reconcile divergent tastes. All such subjects were therefore shut out.

"I am still very busy," he wrote, February 23, 1903, "and all the time I can spare from the garden I give to a new book I am writing—a kind of pot-boiler—though one that I am *immensely* interested in, but that you will not care about."

Many will doubtless be inclined to think, with the writer of the article last week (Nature, p. 322), that Wallace's views on Mendelism were a product of the intellectual rigidity of old age. The facts here brought forward, to which numbers more might have been added, prove, however, that he retained his vitality and elasticity and keenness to a degree that was perfectly marvellous. With regard to Mendelism, he felt, as many far younger men feel, that it is both interesting and important, but that from the first it has been put in a wrong light, and erroneously used as a weapon of attack upon other subjects to which it is not in any way antagonistic.

His attitude towards "Mutation" was different; for here he knew that all the essential facts had been long pondered over by a greater mind than that of any living naturalist. Thus he wrote, July 27, 1907:—

Mutation as a theory is absolutely nothing new—only the assertion that new species originate *always* in sports—for which the evidence adduced is the most meagre and inconclusive of any ever set forth with such pretentious claims!

And again on March 1, 1909, he used words with which a firm believer in natural selection as the motive cause of evolution may fitly conclude:—

I have no doubt, however, it will all come right in the *end*—though the end may be far off, and in the meantime we must simply go on, and show, at every opportunity, that Darwinism actually *does explain* whole fields of phenomena that they [Mutationists] do not even attempt to deal with, or even to approach.

E. B. P.

DR. S. J. P. THEARLE.

Dr. S. J. P. Thearle, whose death is announced, was born in the year 1846, and was thus at the time of his death sixty-seven years of age. He was born in Portsmouth, and entered as an apprentice at Devonport Dockyard in 1860. From this, as the result of competitive examination, he passed into the Royal School of Naval Architecture, South Kensington, in the year 1865, and after three years' study was graduated as a Fellow of the Royal School. He spent eight years in government service as a naval constructor, and then resigned his appointment to become surveyor to Lloyd's Register, in which Society he ultimately rose in the year 1909, after passing several stages, to the position of chief ship surveyor on the retirement of Mr. H. J. Cornish.

One of his most notable achievements was the preparation of several text-books on naval architecture, which became standard books for students for many years, and were so used by teachers in the Science and Art evening classes. Many naval architects feel themselves indebted to Dr. Thearle for their earliest introduction to scientific shipbuilding. These works not only dealt with scientific naval architecture, but also practical ship laying off and ship construction. As a surveyor of Lloyd's Register, he was notable for the independent action in connection with the ships under his survey, while always at the same time being loyal to his Society, and in the carrying out of its rules. His promotion to the senior position in his society was hailed as an excellent appointment, and a merited recognition of his life work.

Latterly the calls upon his time had been exceedingly onerous; he having been appointed on the committee formed to investigate subdivision of ships, under the presidency of Sir Archibald Denny, and on the committee created by the Government to investigate the question of suitable load lines for steamers, on both of which committees he proved himself a most active and useful member. Apart from this, he was in frequent request as a representative of his society. He was also on the Board of Trade Advisory Committee, which since the loss of the *Titanic* has been in more or less constant session.

Dr. Thearle had thus been for the last forty-five years closely identified as an individual and as an official with the progress made in naval architecture, and his contribution to that advance as an official and as a scientific naval architect have been of no mean order. Probably his best-known work during the last years was the reorganisation of Lloyd's rules for the construction of ships, bringing them up to their present position, in which they are abreast of the latest advances in scientific naval architecture.

NOTES.

THE following is a list of those to whom the Royal Society has this year awarded medals. The awards of the Royal medals have received the King's approval:—The Copley medal to Sir Ray Lankester, on the ground of the high scientific value of the researches in zoology carried out by him, and of the researches inspired and suggested by him and carried out by his pupils. A Royal medal to Prof. H. B. Dixon, F.R.S., for his researches in physical chemistry, especially in connection with explosions in gases. A Royal medal to Prof. E. H. Starling, F.R.S., for his contributions to the advancement of physiology. The Davy medal to Prof. R. Meldola, F.R.S., for his work in synthetic chemistry. The Hughes medal to Dr. Alexander Graham Bell, on the ground of his share in the invention of the telephone and more especially the construction of the telephone receiver. The Sylvester medal to Dr. J. W. L. Glaisher, F.R.S., for his mathematical researches.

PROF. J. N. LANGLEY, F.R.S., professor of physiology in the University of Cambridge, has been elected a corresponding member of the Academy of Sciences at Munich.

THE Mary Kingsley medal of the Liverpool School of Tropical Medicine was presented on November 14 to Prof. F. V. Theobald, Vice-Principal and zoologist of the South-Eastern Agricultural College, Wye.

WE regret to see the announcement of the death on November 10, at sixty-four years of age, of Colonel St. George C. Gore, R.E., Surveyor-General of India in the years 1899–1904.

WE notice with regret the death, at fifty-six years of age, of Mr. A. J. Wallis, fellow and bursar of Corpus Christi College, Cambridge. Mr. Wallis was bracketed fourth wrangler in the tripos of 1879, and was also bracketed equal with Prof. M. J. M. Hill, now of University College, London, for the Smith's prizes in that year.

THE death is announced of Dr. R. L. Bowles, at seventy-nine years of age. Dr. Bowles was a fellow of the Royal Society of Medicine, and was for some time president of the south-eastern branch of the British Medical Association. He was the author of a number of papers, including the article "Stertor" in "Quain's Dictionary of Medicine," and articles on the treatment of certain diseases of the heart at Bad Nauheim, the influence of light on the skin, and other subjects.

THE mounted head of an Indian rhinoceros (*Rhinoceros unicornis*), shot in the Nepalese Tarai by the King in 1911, and presented by his Majesty, has been placed on exhibition in the corridor leading to the upper mammal gallery, in the Natural History Museum, South Kensington. This trophy, which has been mounted by Messrs. Rowland Ward, Ltd., is in juxtaposition to the Nepalese tiger presented by the King some month ago, and faces the Hume bequest of Indian big-game heads.

THE authorities of the Natural History Museum, South Kensington, have in preparation an exhibition of a representative series of specimens selected from the collections made by the Scott Antarctic Expedition. The specimens, chiefly marine invertebrates, have been selected by Mr. D. G. Lillie, a member of the scientific staff on board the *Terra Nova*, who is engaged at present in sorting out the collections preparatory to their being sent to specialists to be worked out and described in the monumental report on the scientific results of the expedition, the publication of which has been undertaken by the trustees of the British Museum. The specimens, which are being arranged for exhibition by Dr. W. G. Ridewood, form, of course, only a very small portion of the collections brought home by the *Terra Nova*, but they will serve to show the public some of the more striking and interesting species obtained in southern waters. Two cases in the central hall are being set apart for the purpose.

A SEVERE earthquake is reported to have occurred at Abancay, in Peru, on November 7. According to the meagre accounts which have reached this country two hundred people were killed and many villages were destroyed. Abancay lies about 250 miles east-south-east of Lima, but, so far as known, it seems to have been free from disastrous earthquakes in the past. On November 13 another earthquake, the third since the beginning of October, occurred in the isthmus of Panama, but again without causing any damage to the canal structures.

THE annual conversazione of the Selborne Society will be held on November 21 in the theatre and halls of the Civil Service Commission, Burlington Gardens; as usual, there will be a large display of microscopes, and in the hall devoted to general exhibits an effort will be made to show by means of skins and feathers how wild species of birds and mammals are being saved from extinction by rearing them in captivity, as in the case of the ostrich and the silver fox, by protecting them, and by using the products of truly domesticated species in their place.

AT the anniversary meeting of the Mineralogical Society, held on November 11, the following officers and members of council were elected:—*President*, Dr. A. E. H. Tutton, F.R.S.; *Vice-Presidents*, Prof. H. L. Bowman and Dr. A. Hutchinson; *Treasurer*, Sir William P. Beale, Bart., K.C., M.P.; *General Secretary*, Dr. G. T. Prior, F.R.S.; *Foreign Secretary*, Prof. W. W. Watts, F.R.S.; *Editor of the Journal*, Mr. L. J. Spencer; *Members of Council*, Mr. W. Barlow, F.R.S., Mr. T. Crook, Sir Thomas H. Holland, K.C.I.E., F.R.S., Dr. G. F. H. Smith, Mr. F. H. Butler, Mr. J. P. De Castro, Mr. B. Kitto, Prof. A. Liversidge, F.R.S., Dr. J. J. H. Teall, F.R.S., Mr. F. N. A. Fleischmann, Mr. H. Hilton, and Mr. A. Russell.

MR. AUSTEN CHAMBERLAIN presided at a meeting at the London Chamber of Commerce on November 13 for the purpose of dissolving the subcommittee which had been formed for the purpose of raising funds for the London School of Tropical Medicine. The amount of the fund to date is 71,444*l*., which, after deducting expenses, leaves a balance of 70,431*l.* available for the purposes of the school. Mr. Otto Beit and the Government of the Federated Malay States each contributed 5000*l.*, and Sir William Bennet allocated the Wandsworth bequest of 10,000*l.* to the fund for purposes of research. After deducting the last-named, together with 15,000*l.* spent on new laboratories and hostel and an endowment for certain beds for tropical cases (to be named the "Chamberlain Ward"), there remain 39,000*l.* to form an endowment for the general purposes of the school.

The death is announced of Dr. W. J. Ansorge, the well-known African explorer and natural history collector, at Loanda, Angola, on October 31. Dr. Ansorge was born in Bengal, in 1850, and educated at Pembroke College, Cambridge. His collections, which included mammals, birds, and fishes, were very extensive, and obtained from such widely sundered districts as Angola, Nigeria, Uganda, and British and German East Africa. A large proportion of the collection of birds is in Mr. Rothschild's museum at Tring, but there is also a considerable series in the British Museum, inclusive of 258 skins from Benguela and Uganda, purchased in 1895-6. At least one mammal—*Lophuromys ansorgei*—bears the name of the deceased collector, and in the first two volumes of the British Museum Catalogue of the Fresh-water Fishes of Africa there are eight species named in his honour. A few years ago he presented to the museum several skulls and horns of East African antelopes and rhinoceroses. Dr. Ansorge was the author of "Under the African Sun," published in 1899.

The annual Huxley Memorial Lecture of the Royal Anthropological Institute was delivered on November 14 by Prof. W. J. Sollas, upon the subject of Paviland Cave. The Cave of Paviland, which opens on the face of a steep limestone cave about a mile east of Rhossili, on the coast of Gower (Wales), provided an almost ideal hunting lodge to Palæolithic man. The discovery by Buckland, in the kitchen midden which forms its floor, of a painted skeleton long known as the "Red Lady," rendered it famous. Recent investigation has shown that this skeleton is the remains of a man belonging to the tall Crô-Magnon race, which occupied the greater part of habitable Europe in the Aurignacian age (Upper Palæolithic). The bone of the animals, most of them extinct, found in the cave are in agreement with this conclusion. The associated implements are also Aurignacian. Paviland Cave is thus the most westerly outpost of the Crô-Magnon race, and at the same time the first Aurignacian station yet discovered in Britain. At the conclusion of the lecture the president presented Prof. Sollas with the Huxley memorial medal for 1913.

A few months ago *The Scientific American* offered prizes for the three best essays on the ten greatest patentable inventions of the past twenty-five years. The results were announced in the issue of our contemporary for November 1. No two competitors selected the same set of inventions. In fact, only one invention, that of wireless telegraphy, was conceded unanimously to belong to the group of the ten greatest. The vote on aëroplanes was almost unanimous. But beyond that there was no unanimity. The conditions of the contest stated that greatness would be measured in terms of practical success and general usefulness to mankind; the competitors were limited to machines, devices, and discoveries commercially introduced in the last twenty-five years, and special emphasis was laid on the fact that the inventions must be patentable, although not necessarily patented. A dozen essays were afterwards picked out at random, and these were found to contain forty different subjects. The list of these subjects was published, and readers of *The Scientific American* were invited to vote upon it. The result shows that the vote was not unanimous even on wireless telegraphy. The following twelve inventions secured the highest number of votes, the number printed after each representing a percentage of the votes given:—Wireless telegraphy, 97; aëroplane, 75; X-ray machine, 74; automobile, 66; motion pictures, 63; reinforced concrete, 37; phonograph, 37; incandescent electric lamp, 35; steam turbine, 34; electric car, 34; calculating machine, 33; internal-combustion engine, 33.

A conference of members of the Museums Association and others interested in museum work was held at Warrington on October 30, on the invitation of the committee of the Municipal Museum. Representatives attended of the museums of Liverpool, Manchester, Hull, Bolton, Salford, Leicester, Stoke-on-Trent, and other towns. Mr. P. Entwistle (Liverpool Museum) raised the question how far it was allowable to go in the restoration of imperfect specimens, maintaining the view, with which the meeting generally agreed, that such restoration as was required to give a clear impression of the form of the object was desirable, provided that the extent of the restoration were obvious on close examination. Dr. Tattersall (Manchester Museum), in a paper on museums and local collections, with the outlines of a scheme for the compilation of a fauna of Lancashire, said that the first duty of a provincial museum was to collect and preserve specimens illustrating the natural history of the surrounding district, and proposed that an organisation should be formed to link up the existing museums in Lancashire with the various natural science societies, and specialists in various zoological groups. The museums would receive the specimens collected locally and forward them to appointed centres, where they would be named and recorded, and returned when dealt with to the same museums for permanent preservation. A committee was appointed, with Dr. Tattersall as convener, to take preliminary steps to carry out the scheme. Mr. Madeley (Warrington Museum) announced that it was proposed, provided a sufficient number of museums agreed to subscribe, to prepare and distribute a series of casts of, say twenty, typical British stone implements from the British Museum collections. The selection would be made by Sir Hercules Read, who had also kindly consented to prepare a description to accompany the casts.

Prof. A. Keith, in the November issue of *Man*, describes two ancient crania found by the Rev. H. Mason in an old deposit at Wanganui, New Zealand. They belong to the Moriori race, now confined—a mere remnant—to the Chatham Islands. They inhabited New Zealand before the arrival of the Maori, and their crania differ in a remarkable degree from those of the latter race. The Moriori skulls are devoid of negroid characteristics, the stock to which the Maori are more closely allied. The Moriori are evidently related to some of the Polynesian and South American races; at least it is among these peoples that we find cranial forms which are comparable with them.

We have received from the Land Agents' Society a copy of the seventh annual report of the honorary consulting biologist, in which Mr. W. E. Collinge, after referring to the spell of wet in 1912 as having been favourable to animal pests and inimical to game-birds, mentions some of the most serious cases of damage by insects and other pests which occurred during the year, with the best remedial measures for such infestations.

In the October number of *The American Naturalist* Prof. W. S. Anderson insists on the importance of the study of the inheritance of coat-colour in horses. "If," he remarks, "there is a law governing the transmission of colour, may we not infer that a law of somewhat like nature will govern the transmission of the more essential qualities of the horse? If it can be proved that colours are unit characters and their inheritance obeys the Mendelian law of dominants and recessives, I believe one very important step will have been taken to solve the whole problem of breeding horses." Very noteworthy is the fact that when chestnut horses are mated with one another the progeny all seem to inherit the (recessive) colour of their parents, the recorded exceptions of one per cent. being probably due to error.

In the current number of *The Journal of Agricultural Science* (vol. v., part 4) Messrs. W. A. Davis and A. J. Daish contribute a study of the methods of estimation of carbohydrates, especially in plant extracts. Certain sources of error encountered in the estimation of sugars in plant extracts, particularly of cane-sugar and maltose, are dealt with. A new method of estimating maltose, based on the use of pure cultures of maltase-free yeasts, such as *Saccharomyces marxianus* and *S. exiguus* has been devised. This is the only one available in such cases, as the ordinary method, using dilute hydrochloric acid for the hydrolysis of maltose, leads to destruction of much lævulose and to quite erroneous results. A scheme for the analysis of the complex mixtures of sugars, namely pentoses, dextrose, lævulose, cane-sugar, and maltose, occurring in plant extracts is appended. Mr. Davis also describes, in a separate paper, a simple laboratory apparatus for the continuous evaporation *in vacuo* of large volumes of liquids, such as plant extracts, which under the ordinary conditions froth badly and thus present difficulties.

The Journal of Economic Biology for September contains a valuable "General Survey of the Insect Fauna of the Soil," by Mr. A. E. Cameron, of the department of agricultural zoology in the University of Manchester. The researches described have been carried out in the grounds at Fallowfield attached to the economic laboratory, and from this small area a wonderful amount of interesting information has been obtained. The author gives a catalogue of more than 150 species of Apterygota, Coleoptera, Lepidoptera, Diptera, and Hymenoptera found in the soil at least during some stage of their life-history, together with the depth and nature of their habitat and observations on their food. He also discusses the effect exerted by these terrestrial insects on the soil as regards moisture, temperature, and ventilation—all factors of great cultural importance. It is regrettable that this excellent paper is disfigured by an abnormal number of misprints, and we do not understand why the explanations of some of the well-drawn figures of larvæ are given in German rather than in English.

The October number of *The Journal of Genetics* (vol. iii., No. 2) contains papers of very varied interest. Prof. Punnett and Miss Pellew deal with gametic reduplication ("coupling") in sweet-peas and peas. Prof. Punnett gives evidence that when two dominant factors are introduced into a double heterozygote from different parents, the ratio of "repulsion" is the same as that of the coupling found when they are introduced from the same parent. When three factors are concerned together, the ratios between any two of them are modified, and he shows that the modification appears to agree with Trow's hypothesis of secondary reduplication. Mr. J. C. F. Fryer gives a preliminary account of Mendelian segregation in a sexually dimorphic Phasmid, in which the females differ in two pairs of characters; perhaps his most interesting observation is that typical Mendelian segregation may occur in parthenogenetic reproduction. Mr. E. N. Wentworth shows that strains of Drosophila (Diptera) of very different fecundity may arise by inbreeding from one pair, and suggests that loss of fecundity on inbreeding may be due simply to the segregation of such strains of low fertility. Pure strains of high fertility showed no loss in eight generations of inbreeding. Mr. C. Todd gives a lucid account of hæmolytic tests, showing that not only phylogenetic relationship may be tested in this way, but also that each individual has characteristic blood-corpuscles, the fate of which, when injected into another individual, can be followed. He gives indications of the hereditary transmission of these individual blood-characters. Mr. C. J. Bond shows that after apparently complete removal of the testicular tissue of birds, a full-sized testis may be regenerated, and suggests that the proportions of gametes bearing different hereditary characters may differ in the regenerated testis from those existing in the normal testis.

An important investigation, entitled "Cloud and Sunshine of the Mediterranean Region," by Mr. J. Friedemann forms Part 2, vol. xxxv., of *Archiv der Deutschen Seewarte*. The area dealt with extends to many parts beyond the Mediterranean district, and includes data from no fewer than twelve meteorological services. Many of the observations have been already published in widely scattered volumes; one of the merits of the present discussion is the bringing together of the separate data. The monthly, seasonal, and yearly distributions of the elements in question are shown in great detail; to obtain a satisfactory idea of these it will be necessary to refer to the original paper, which is accompanied by numerous tables and several coloured charts. One of the diagrams, however, consists of isopleths showing the variation of the yearly range of the amount of cloud on both sides of a line from Little St. Bernard to Beni Suef (Egypt). From this may be seen, *inter alia*, the peculiarities of the range at alpine stations, the rather cloudy condition of the Apennines, the decrease to the south-east, the small amount on the west of Greece, especially in summer, and the great differences in the Ægean Sea. A large part of this laborious work was prepared by the late Mr. F. Zillmann at the instigation of Prof. Partsch.

The October number of the Journal of the Institution of Electrical Engineers is devoted almost exclusively to the subject of electric traction. At the joint meeting of the Institution and the Société Internationale des Electriciens, held in Paris in May, the question of the electrification of existing railways was widely discussed, and it seems evident that the problem is no longer a technical one but is now purely financial. The difficulties of construction and maintenance have been overcome, and direct-current and single and three-phase systems are all now in operation. While each of these three systems claims to be more economical than steam traction, there does not appear to be any certainty as to which of them is best. On the whole the papers read and the discussion which followed them tended to favour the continuous system with much higher voltages—*e.g.* 2400—than are usual at present, but it was evidently felt even by the advocates of such a system that there were circumstances under which the other two systems might be used with advantage.

At a meeting of the Alchemical Society held on November 14, a paper was read by Mme. Isabelle de Steiger, entitled "The Hermetic Mystery," the chair being occupied by the acting president, Mr. H. Stanley Redgrove. Mme. Isabelle de Steiger's interpretation of the theories and aims of the ancient and medieval alchemists differs radically from that accepted by many students of the history of philosophy and science, her views in the main agreeing with those expressed in that well-known but exceedingly scarce work, "A Suggestive Enquiry into the Hermetic Mystery and Alchemy" According to the lecturer, the doctrines underlaying alchemy were the primitive doctrines at the heart of every ancient religion. Alchemy, she maintained, was not concerned with metals but with man, whom the alchemists endeavoured spiritually to perfect through a process analogous to that said to have been discovered by Mesmer. The alchemists, she said, formed a sort of free secret order, and their writings were crypto grammatic, being intended to be understood by one another only. They were couched in the language of chemistry to mislead the ignorant, this being necessary on account of the danger attendant upon any misuse of the processes with which they dealt. The full text of the lecture will be published in the November number of the society's Journal.

An article by Mr. W. A. Caspari, entitled "British Chemistry and British Manufactures," is published in the November issue of *The British Review*. Mr. Caspari insists again upon the importance of the manufacturers of this country learning to appreciate the value to their industries of the services of highly qualified men of science. In the application of chemistry to industrial objects, Great Britain was the pioneer and undisputed leader during the earlier periods of the industrial revival. At present Germany stands easily supreme in all purely chemical manufactures, except possibly metallurgy and "heavy chemicals"; and the potency of German competition resides in clear-thinking German appreciation of applied science. Mr. Caspari asks: What is wrong? Too many of our manufacturers prefer to run their works with clerks, engineers, and "practical" men; in Germany, the chemical element in the *personnel* of the factory is strong, not only numerically, but also as regards rank. The British manufacturer's mind seldom soars beyond the conception that a chemist is a person who analyses things. He too often fails to realise that the scientific man, far from being merely a useful background accessory like the works' plumber, holds the key to the whole of his manufacture. Mr. Caspari makes some wise suggestions for the more suitable training of chemists in universities and colleges, and maintains that once the suitable type of chemist is produced and planted in our factories, our industrial system will evolve almost imperceptibly in the right direction, and our captains of industry with it.

Messrs. H. F. Angus and Co., 83 Wigmore Street, London, W., have issued a catalogue of second-hand microscopes, objectives, and accessories, which they have for sale or hire. In addition to second-hand instruments, Messrs. Angus have in stock some forty or more different patterns in microscopes and an equal variety in accessory apparatus, which include specimens of English, American, Austrian, German, Italian, and Swedish manufacture. It should prove a great convenience to purchasers to be able easily to compare instruments of varied character and range.

The following books are announced, as in the press or in preparation, by the Cambridge University Press:—In the "Cambridge Psychological Library": "Psychology," Prof. J. Ward; "The Nervous System," Prof. C. S. Sherrington, F.R.S.; "The Structure of the Nervous System and the Sense Organs," Prof. G. Elliot Smith, F.R.S.; "Prolegomena to Psychology," Prof. G. Dawes Hicks; "Psychology in Relation to Theory of Knowledge," Prof. G. F. Stout; "Mental Measurement," Dr. W. Brown; "The Psychology of Mental Differences,"

C. Burt; "Collective Psychology," W. McDougall, F.R.S.; "The Psychology of Personality and Suggestion," T. W. Mitchell; "The Psychology of Dreams," T. H. Pear. In the "Cambridge Technical Series":—"Automobile Engineering," A. Graham Clark; "Electro-Technical Measurements," A. E. Moore; "Applied Mechanics," E. S. Andrews; "Alternating Currents," W. H. N. James; "Chemistry and Technology of Oils and Fats," F. E. Weston; "Paper, its Uses and Testing," S. Leicester; "Mining Geology," Prof. G. Knox; "Textile Calculations—Materials, Yarns, and Fabrics," A. M. Bell; "Domestic Science," C. W. Hale; "Business Methods," Thomas Hart, jun.; "Electrical Engineering," T. C. Baillie; "Applied Mechanics and Heat Engines," F. Boulden; "Elements of Applied Optics," W. R. Bower; "Physics for Engineers," J. F. Yorke; "English Building Construction," C. F. Innocent; "Sculpture in Relation to Architecture," T. P. Bennett; "Electric Installations," C. W. Hill; "Accounting," J. B. Wardaugh; "The Theory and Practice of Commerce," J. C. Stephenson. In the "Cambridge Health Series": "The Bacteriological Analysis of Water, Sewage and Foods," Dr. W. G. Savage; "Isolation Hospitals," Dr. H. F. Parsons. In the "Provincial Geographies of India": "Bengal and Orissa," L. S. S. O'Malley; "The Punjab, N.W. Frontier Province, and Kashmir," Sir J. McC. Douie.

OUR ASTRONOMICAL COLUMN.

COMET NEWS.—Miss Anna R. Kidder, of the Berkeley Astronomical Observatory, communicates to the Lick Observatory Bulletin, No. 245, the elliptic elements and ephemeris of comet 1913*e* (Zinner). The elements she has computed correspond so closely to those of comet 1900 III. (Giacobini) that she concludes that both comets are identical. The two sets of elements are as follows:—

	Comet 1900 III. (Giacobini)		Comet 1913*e* (Zinner)	
T	1900, Nov. 28·17		1913, Nov. 2·1047 G.M.T.	
ω	171° 29′	1900·0	171° 29·1′	1913·0
Ω	196 32		195 27·3	
i	29 52		31 01·1	
q	0·9342		0·97787	
e	0·74168		0·72968	

The average period derived from the dates of perihelion passage in 1900 and 1913 is 6·464 years.

Two publications, namely the Lick Observatory Bulletin, No. 239, and the Lowell Observatory Bulletin, No. 57, contain accounts of photographs secured at the respective observatories. In the former, Dr. C. C. Kiess describes the observations made on comet 1911*c* (Brooks) and illustrates his descriptions with ten excellent reproductions. In the latter communication Mr. C. O. Lampland describes fully the photographs secured at the Lowell Observatory of the fine comet 1910*a*. A large series of most striking photographs is also reproduced. In the addenda to the paper he discusses the heliographic positions of this comet, and adds some remarks in connection with the heliographic latitudes of Donati's comet (1858 VI.), and Chéseaux's comet (1744 I.) when near perihelion.

MAGNIFYING POWERS USED BY DOUBLE-STAR OBSERVERS.—Mr. T. Lewis, writing in *The Observatory* for November, brings together some very interesting facts relating to the magnifying powers used by double-star observers. The object of the inquiry was to answer the question, "What is the best magnifying power of a telescope in actual practice?" and, in the hope of arriving at some definite result, he made counts of thousands of observations all over the world by various observers. The result of the investigation was to produce a formula—

$$\text{Magnifying power} = 140\sqrt{A}.$$

where A is the diameter of the aperture, in inches, and this formula gives an excellent representation of the values derived from the discussion of the actual observational data. Thus the formula, as Mr. Lewis says, "may safely be taken as representing the consensus of opinion among experienced observers in their choice of the best magnification for a given telescope; and it may, therefore, be useful as a guide to others in selecting the eyepieces which will best suit their particular telescope."

STELLAR CLASSIFICATION.—At the Lick Observatory much work has recently been accomplished in the classification of stellar spectra. Bulletins 237 and 243 contain two researches in this subject, both of which have been carried through by candidates for the degree of doctor of philosophy in the University of California, a fact which indicates the increased attention now being devoted to this section of astrophysics. The first of these papers deals with "Class B Stars whose Spectra Contain Brignt Hydrogen Lines," and is the work of Mr. Paul W. Merrill.

By using plates stained with Wallace's three-dye stain the spectrograms included Hα. Five slit-prism spectrographs giving dispersions ranging from 8·7 A per mm. at Hγ, and one grating spectrograph giving in the second order at Hα (with that line central) 10·9 A per mm. were employed, attached to the 36-in. refractor.

The survey included nearly all the stars of the above description north of $-40°$, and some related stars; also some stars included either because on three-prism spectrograms Hβ was peculiar, or the lines were weak and diffuse in order to see whether Hα might be bright. The bright components of the Hβ line of γ Cassiopeiæ and b_2 Cygni were tested, with negative results, for polarisation. The author confirms the presence of the chromospheric lines $\lambda\lambda$4924 and 5018 in these stars, first pointed out by Sir Norman Lockyer and Mr. Baxandall in 1905. With regard to the doubling of the bright hydrogen lines, complex self-reversal is suggested as the explanation most in accord with the facts. Finally, Mr. Merrill divides these stars into four groups, of which the types are γ Cassiopeiæ, b^2 Cygni, Electra, and ϕ Persei. The groups contain fourteen, nineteen, two, and three stars respectively, whilst six stars remain unclassified. The variability and distribution of these stars also receives attention.

Bulletin 243 contains a photographic study of the visual region of the spectra of the brighter Class A stars, by Miss E. Phœbe Waterman. The line of greatest wave-length measured was λ6517, of unknown origin. Miss Cannon's proposal to rearrange the classification of these stars is supported; the stars now classified as A would thus be divided between classes A0 to A2. In the summary it is stated that the metal lines present are the enhanced or spark lines of the elements represented. They coincide throughout in wave-length and intensity with the stronger lines of the solar chromosphere. The peculiarity of the spectrum of α Cygni is found to consist in the great intensity of some of the iron lines, and in the narrow and well-defined character of all the lines rather than in the presence of lines foreign to stars of Class A. Miss Waterman finds that some stars perhaps show bright borders to the absorption lines.

INTERNATIONAL CONFERENCE ON THE SAFETY OF LIFE AT SEA.

THE International Conference on the Safety of Life at Sea was opened by the President of the Board of Trade on November 12, at the Foreign Office, in the presence of delegates from Germany, the United States of America, Australia, Austria-Hungary, Belgium, Canada, Denmark, Spain, France, Great Britain, Italy, Norway, Netherlands, Russia, Sweden, and New Zealand.

After offering a warm welcome to the delegates on behalf of the British Government, and an expression of their gratification at the cordial manner their invitation to the conference had been accepted, Mr. Buxton alluded to the importance of the task before them, and ventured on the opinion that few international conferences had had a greater and nobler work entrusted to them.

With regard to the questions to be discussed, he considered that they could be divided broadly into five heads. These may be summarised as follow:—(1) Is it possible to eliminate the liability to founder by constructional arrangements? (2) In the event of collision, fire, and other accidents, what life apparatus are required to minimise disaster and to save life? (3) What organisations are best to ensure the effective and expeditious handling of life-saving appliances on board the ship herself and the rescuing ship? (4) How can assistance from another ship or from shore be most quickly and effectively invoked and obtained? (5) What measures can be taken on behalf of the ships to avert or diminish the risk of accident, under which head come the observation and reporting of ice and derelicts, storm and fog signals, and warnings, &c.?

The President of the Board of Trade then read a message of cordial welcome to the delegates from the King, in which his Majesty referred to his personal experience as a sailor of many of the matters that would be considered by the conference, and to the special interest he took in the questions they were about to consider, affecting as they did the lives of so vast a number of his subjects.

An interesting speech from Dr. von Koerner, the chief German delegate, followed.

Lord Mersey, who was unanimously elected president, after thanking the delegates for the honour they had conferred upon him, pointed out that while means have to be taken to secure comparative immunity from risk, the practical requirements of business must be borne in mind. "Perfection," he said, "can sometimes be reached at too great a cost. But while remembering these two considerations, I would suggest that where doubt exists, the tendency should always lean towards the line of safety rather than towards the line of economy." Lord Mersey went on to say that increased cost incurred in the interest of safety will be cheerfully met by the public, who, after all, are those who have to pay.

After luncheon at the Foreign Office, Sir Edward Grey and M. Guernier, the chief French delegate, were the principal speakers. The former remarked that, though international, the conference caused no anxiety diplomatically, because, unlike some which arouse the rivalry of nations, it sprang from one of those human tragedies in history which only cause sympathy among the nations.

AGRICULTURAL ENTOMOLOGY IN THE UNIVERSITY OF MANCHESTER.

THE new laboratory for research work in agricultural entomology in the University of Manchester is situated at the top of the north-east corner of the University buildings in Oxford Road. Its position gives easy access to the general zoological laboratories on the floor below and to the collections of the Manchester Museum in the same building. It is a lofty room, 58 ft. in length by 28 ft. wide, with accommodation for five or six persons engaged in original investigations. The windows under which the working benches are placed face due north, and two large skylights in the sloping roof give illumination on the south side of the room. Leading out of the main laboratory there is a private room for the reader in agricultural entomology, 17 ft. by 17 ft., with a staircase leading to a working place raised above the floor level.

At a distance of about a mile from the University and on the main tram route, there is an experimental field with glass houses and a small laboratory, where the insectaria can be erected, trees planted, and other arrangements made for breeding and observing insect life. The University, moreover, is working in cooperation with the Cheshire County Council, and facilities will be offered for entomological work on the farm lands connected with the Agricultural College at Holmes Chapel. The scheme of work has been approved by the Board of Agriculture and Fisheries, and the expenses will be met by a grant of one-third of the total amount by the council of the University and two-thirds from the Development Fund.

[*Photo. C. Ireland, Manchester.*

Laboratory for Agricultural Entomology in the University of Manchester.

The University has appointed Dr. A. D. Imms, formerly forest entomologist to the Government of India, to be the first reader in agricultural entomology, and he will conduct researches and superintend the work of research students in the laboratory.

The reader in agricultural entomology will give occasional lectures in the University on the subject of the researches conducted in the department, and may give advice or assistance to students reading for the honours school of zoology who are taking the Insecta as a special subject; but the department will not be concerned in the ordinary course with instruction given to students for the degree examinations of the University. It is anticipated, however, that a certain number of post-graduate students will be offered facilities for the conduct of original research in the University, and such students will be eligible to apply for the M.Sc. degree after a course of two years' research work in the University.

The new laboratory was opened on November 13 by Sir Sydney Olivier, the Permanent Secretary of the Board of Agriculture and Fisheries, in the absence of Mr. Walter Runciman, the President of the Board, who was detained in London by a meeting of the Cabinet Council. At the opening ceremony, Dr. Imms gave a short sketch of the aims and scope of agricultural entomology, and Sir Sydney Olivier, in declaring the laboratory open, explained the policy of the Board as regards the endowment of the universities and agricultural institutions for research work in agricultural science.

At the conclusion of the ceremony a number of exhibits of the research work done in the department and of the apparatus used in entomological investigations was shown to the visitors in the zoological laboratories and museum. S. J. HICKSON.

THE PASSIVITY OF METALS.

A GROUP of eight papers brought together with the view of setting forth every aspect of "passivity" as it presents itself to those now actively engaged in working out a satisfactory explanation of this most difficult and elusive subject, was discussed at the meeting of the Faraday Society on November 12.

The theoretical importance of passivity lies in the fact that it is in all probability so closely bound up with the fundamental mechanism of electrolytic action that a proper understanding of its cause will go far towards clearing away many of the difficulties which still surround the simple processes of anodic solution and kathodic deposition. It has further an important practical bearing on corrosion, for if this be an electrolytic action, a non-corrodible metal and a passive metal are, anyhow within certain limits, synonymous terms. The very idea of the connection suggests a line of research on non-corrodible alloys that may lead to most fruitful results. But if the subject is important, it is no less perplexing. At present two theories, in many respects diametrically opposed to one another, would appear to hold the field, one of which, broadly speaking, ascribes passivity to the presence of oxygen in some form or another, and the other to hydrogen. It may be added that the advocates of each theory point to an *experimentum crucis* claimed to prove the impossibility of its rival as a satisfactory explanation of all the phenomena which have been observed.

While attention was concentrated on the original observation made in 1790 by Keir, that iron became "passive" or indissoluble after plunging into strong nitric acid, the simple mechanical explanation that the change of state was due to a close film of protective oxide no doubt seemed all-sufficient. It was only when passivity was studied as an electrolytic phenomenon, as an example of anodic polarisation by which the passive metal rises higher in the electrolytic scale towards the "noble" metals than it was in its active state, that a broader interpretation was called for, and hence was put forward Le Blanc's fruitful conception that the retarded anodic action was chemical and not mechanical in its origin, and that it must be explained as arising from the diminished reaction-velocity of some chemical process taking place at the anode. This conception is now universally adopted in the consideration of passivity phenomena; the only question arising is, What is the reaction the velocity of which is diminished when metals become passive?

To this question the following answers were given in the papers presented for discussion.

(1) Adopting the current view of Nernst that electrode potential is a result of the formation of metallic ions when the electrode is placed into an electrolyte, Dr. G. Grube supposes this action to be retarded under conditions known as passive by the formation of an alloy of anode surface and oxygen, which has a lower solution pressure than the pure metal. Such retardation of anodic action is known to take place when a platinum anode is used in the electrolysis of halogen salts, and for the self-same reason, and analogous kathodic retardation was likewise shown to exist by Dr. Grube; for example, when zinc and hydrogen are deposited simultaneously with iron. Much the same theory was developed by Dr. D. Reichinstein direct from the Nernst formula, and experimental support was given to the theory by Dr. H. S. Allen, who showed that the photo-electric behaviour of iron—its property of losing negative electricity under the action of light—which from considerations of "fatigue" is believed also to be due to the state of the gaseous film on the metal, increases or diminishes in intensity according as the iron is in the active or passive state.

(2) In order to take into consideration the specific properties of the electrolyte anion some investigators are now reverting to the old Grotthus view of electrolysis that the primary action at the anode is not the formation of metallic ions, but a discharge of negative ions (anions). Prof. Leblanc, however, further supposes that the anion is hydrated, and that passivity is merely the retardation of the reversible reaction, ion − hydrate $\rightleftharpoons$ ion + water Prof. E. Schoch also adopts the theory of primary anion discharge, but impressed by Dr. Günther Schulze's experiments on the structure of aluminium anode-films, he considers that under certain conditions of current density, temperature, &c., there will be a diminished rate of reaction between anions and electrode owing to the formation on the latter of a film of oxide or oxygen. Neither of these theories, which seem to make gratuitous and unnecessary assumptions, were received with much favour.

(3) More attractive is the hydrogen theory stated in the paper presented by Prof. G. Schmidt, and supported by some ingenious and striking experiments. This supposes that the passive condition is normal, and that metals like iron and chromium are only rendered active by the diffusion through them of hydrogen, which acts as a catalyst and sets up local action. Possibly this is often the case, but it is doubtful whether the "hydrogen-activation" theory will explain all cases of passivity. In the end it may be found, as Dr. G. Senter said in the course of the discussion, that no one theory will cover every case of passivity, but the sense of the meeting was certainly in favour of either an oxygen-film or an oxygen surface alloy as offering in most cases a satisfactory working hypothesis of the passive state.

UNIVERSITY EDUCATION IN LONDON.

THE President of the Board of Education has sent to the Vice-Chancellor of London University an important letter in which he announces that the Government accepts in general the recommendations of the Royal Commission on University Education in London, and is prepared to act upon them. The letter is as follows:—

Board of Education, Whitehall, S.W.,
Nov. 12, 1913.

DEAR MR. HERRINGHAM,—1. I am very anxious that the position of the Government in regard to the proposed reconstitution of the University should be generally realised, and that discussion should not be obscured by any misunderstanding on the subject. I am, therefore, venturing to set out in the form of a letter to yourself as Vice-Chancellor of the University the substance of what I said at the Mansion House the other day.

2. As you are aware, I have appointed a Departmental Committee to consult the bodies and persons concerned and to recommend the special arrangements and provisions which may be immediately adopted for the purpose of giving effect to the scheme of the report and as the basis of the necessary legislation. The committee will not attempt to go again over the ground covered by the Royal Commission. The Government, after careful consideration, have decided that the scheme of the report is calculated to produce a University of London worthy of the name. Starting from this point it will be the business of the Departmental Committee to discover how far the numerous bodies and persons concerned are prepared to cooperate on the basis of the principles underlying the scheme.

3. Those principles are in themselves simple. They may be shortly stated as follows:—

(1) That the Government of the University, and particularly its financial administration, shall be entrusted to a small Senate predominantly lay in its composition and not representative of special interests; and

(2) That on the other hand the control of the teaching and the examinations of students in colleges of the University shall be in the hands of the teachers;

(3) That the educational and financial control of the constituent colleges shall be vested in the University; and

(4) That as much of the University work as possible, together with the University administration, should be concentrated in a central University quarter. (The question of the particular site to be selected is one on which the Departmental Committee will be able to advise the Government after they have considered the various alternatives that have been proposed);

(5) The scheme of reconstruction should provide effectively for continuance of access to University examinations by external students—*i.e.*, by those who are not attached to any college or school of the University.

4. As regards the future of the Imperial College, I may say that it has never been proposed that the college should be moved from its present site. It is, however, an essential part of the scheme that it should become a constituent college of the new University under "the educational and financial control" of the Senate. I ought to explain that the word "incorporation," which is sometimes used as a convenient term to describe the position of a constituent college under such control, does not imply any such vesting of the property of the constituent college in the University as would preclude the earmarking of capital or income by donors and benefactors for particular institutions or specific purposes. This applies to past no less than to future gifts. Such a restriction is not contemplated by the Government, and, speaking for myself, it would be contrary to the views which I have more than once expressed as to the value of local and private munificence in maintaining the highest standard of educational development.

5. On the conclusion of the necessary negotiations the Government hope to introduce legislation in due course to give effect to these principles, and I see no reason why sufficient agreement should not be arrived at to secure the acceptance of the Bill in Parliament as a non-contentious measure.

6. I trust that this statement, which I have already made in public, will be of assistance to all who are from whatever point of view interested in the work of reconstruction by defining the area within which amendments and modifications of the scheme of the committee are admissible. Particularly would I ask of them that they should not reject the scheme because in this point or in that it may fall short of their ideals or is even contrary to what they think best. Some acquiescence or even sacrifice on individual points will be necessary for all concerned if a scheme worth having is to be carried out. It must be remembered that the scheme of the Royal Commission is the only one in the field and that if it fails of accomplishment all chance of reform and progressive development may be gone for many years. In these circumstances and with a definite statement of principles before them I trust that they will not hesitate to make some mutual surrender of views and opinions which perhaps owe their origin in large measure to the uncertainty which has so long prevailed even as to the main lines of reconstruction.

7. The Government will be prepared, in the event of the scheme taking shape in legislation, to make substantial new contributions to the resources of the University, and they are confident that the establishment of a University worthy of the capital of the Empire will be regarded by the citizens, Livery Companies, and corporate bodies of London equally with the Government as an object deserving of their interest and support.

8. I am sending a copy of this letter to the Press.

Yours faithfully,

JOSEPH A. PEASE.

W. P. Herringham, Esq., M.D., &c.

THE PREPARATION OF EYE-PRESERVING GLASS FOR SPECTACLES.[1]

Since March, 1909—in connection with the Glass Workers' Cataract Committee of the Royal Society—I have been experimenting on the effect of adding various metallic oxides to the constituents of glass in order to cut off the invisible rays at the infra-red end of the spectrum, and thus to prepare a glass which will cut off those rays from highly heated molten glass which damage the eyes of workmen, without obscuring too much light or materially affecting the colours of objects seen through the glass when fashioned into spectacles.

Single metals were at first tried in varying quantities to see if from the colour and properties communicated to the glass they were worth further examination. Each specimen is cut and polished into a plate 2 mm. thick. The plate so prepared is first put into the radiometer balance to find the percentage of heat cut off. It is then tested in the spectrum apparatus to ascertain the upper limit of transmission of the ultra-violet rays; next it is tested in Chapman Jones's opacity meter to estimate the percentage of luminous rays transmitted, and finally the colour is registered in a Lovibond's tintometer.

The following elements were selected as likely to be worthy of further experimentation by combining the metals, two, three, or four at a time in one glass so as to enable the advantages of one to make up for the shortcomings of another:—Cerium, chromium, cobalt, copper, iron, lead, manganese, neodymium, nickel, praseodymium, and uranium.

Whilst bearing in mind that the chief object of

[1] Summary of a paper read before the Royal Society on November 13 by Sir William Crookes, O.M., F.R.S.

this research is to find a glass that will cut off as much as possible of the heat radiation, I have also attacked the problem from the ultra-violet and the transparency points of view. Taking each of these desiderata by itself, I have succeeded in preparing glasses which cut off more than 90 per cent. of heat radiation, which are opaque to the invisible ultra-violet rays, and are sufficiently free from colour to be capable of use as spectacles. But I have not been able to combine in one specimen of glass these three desiderata in the highest degree. The ideal glass which will transmit all the colours of the spectrum, cutting off the invisible rays at each end, is still to be discovered.

So far as transparency, however, is concerned, it will not be an unmixed advantage for the sought-for glass to be quite clear and colourless. The glare of a strong light on white cliffs, expanses of snow, electric light, &c., is known to be injurious to the eye, and therefore a tinted glass combining good obstruction to the heat radiation and ultra-violet rays is the best to aim for.

For ordinary use, when no special protection against heat radiation is needed, the choice will depend on whether the ultra-violet or the luminous rays are most to be suppressed, or whether the two together are to be toned down. Ordinarily the visible spectrum is assumed to end at the Fraunhofer line K, λ 3933, but light can easily be distinguished some distance beyond by the naked eye. It may therefore be considered that the ultra-violet rays which are to be cut off on account of their possible injurious action are those of shorter wave-lengths than, say, λ 3700. Many glasses have been prepared for this purpose, all of which are opaque to rays shorter than λ 3700. The colours are pale green, yellow, and neutral; they transmit ample light so that a choice of tints is available to suit individual taste.

Glasses which are restful to the eyes in the glare of the sun on chalk cliffs, expanses of snow, or reflected from the sea, of yellow, green, and neutral tints, have also been prepared which have the advantage of cutting off practically all the ultra-violet rays and also a considerable amount of the heat radiation.

GEOLOGY AT THE BRITISH ASSOCIATION.

ON the conclusion of Prof. E. J. Garwood's presidential address, which has been published in full in a previous issue, Prof. Lapworth gave an address on the geology and physical geography of the country round Birmingham, which was supplemented by a description of the igneous rocks of the district by Prof. W. W. Watts. Prof. Lapworth's address dealt with the broad features of the topography and stratigraphy of the area, special reference being made to some of the places to be visited on the field excursions.

Mr. George Barrow described the typical Spirorbis Limestone of North Warwickshire as a rather compact rock, usually grey, and containing *Spirorbis carbonarius*. Two main beds occur, the Index Limestone about 100 ft. down in the Halesowen group, and another less persistent bed close to the base of the Keele group. There are other less continuous bands, and also lenticles and scattered nodules. He attributed the formation of the limestone to the evaporation of shallow sheets of lime-bearing water, a view which is supported by the structure of the rock, during a dry epoch, subject to sudden or periodical floods.

The stream-courses of the Black Country plateau formed the subject of a communication by Mr. Henry Kay. The area was described as including the anticline of the South Staffordshire Coalfield *plus* the north-western parts of Cannock Chase and the Warley-Barr area. The chief physical feature is the midland watershed which runs across the plateau from Wolverhampton to the Lickeys. The Trent drains the larger part of the area, but the southward marginal drainage flows into the Severn. The Trent drainage area has been subjected to excessive piracy and has steadily suffered loss. The northern drainage is consequent on the formation of the South Staffordshire anticline, regarding the age of which it bears notable evidence. The author states that the uplift is, in part at least, post-Tertiary.

Prof. Sollas exhibited a number of flints showing outlines similar to those described as "rostro-carinate," and supposed to be of human workmanship. He described the conditions under which they were found, and expressed his firm belief in their formation by the action of surf upon nodules of flint partially embedded in the deposits of the beach, the curved keel being produced by the intersection of two conchoidal fracture-surfaces.

In a paper on the structure of the Lias Ironstone of South Warwickshire and Oxfordshire Mr. E. A. Walford inferred that the sea-floor of the Middle Lias was a tangle of crinoid growth, stage above stage. He described beds of the Middle Lias stone as packed with curved and interlacing stems lying upon the bedding plane, with other beds of the fine pentangular and smaller ossicles of crinoids between.

Mr. T. C. Cantrill described the occurrence of *Estheria*, cf. *minuta*, in the Bunter pebble bed of Ogley Hay, near Walsall. The fossils were found in two thin bands of red marl in a disused sand-quarry.

The flora and fauna of the Upper Keuper Sandstones of Warwickshire and Worcestershire formed the subject of a communication by Messrs. L. J. Wills and W. Campbell Smith. They described for the first time from the English Trias examples of the foliage and scales of the female cone of a Voltzia, closely resembling *V. heterophylla*, of the Bunter of the Vosges, and recorded new occurrences of Voltzia, Schizonema, Carpolithus, and, possibly, Yuccites. The fauna includes *Phaebodus brodiei*, Semionotus, and Ceratodus, also the lamellibranch *Thracia? brodiei*, and the authors conclude "that we are not dealing with a pre-Rhætic incursion of the sea, but with a littoral facies of the Keuper Marls, formed where the water was at times sufficiently fresh to support a small fish-fauna and in sufficient motion to move coarse sediments."

Nodules from the Basal Ordovician conglomerate at Bryn Glas, Ffestiniog, were exhibited by Prof. W. G. Fearnsides, and some discussion as to their nature and origin took place.

Dr. A. Vaughan made a communication on the division between the Lower and Upper Avonian with a view to the discussion of several important questions of nomenclature.

Mr. F. G. Meachem contributed a paper on the progress of the coal-mining industry of the South Midlands since the year 1836, from which the following figures are quoted:—

Areas of the Known Coalfields of the Area in Square Miles.

	1836	1913
South Staffs	70	360
Leicester	20	88
Warwick	10	222
Salop	20	96
Total	120	766

Output in Millions of Tons.

	1865	1912
South Staffs	10	$7\frac{1}{2}$
Leicester	$1\frac{1}{2}$	$2\frac{3}{4}$
Warwick	$\frac{3}{4}$	$4\frac{1}{2}$
Salop	$1\frac{1}{2}$	$\frac{3}{4}$
Total	$13\frac{3}{4}$	$15\frac{1}{2}$

Dr. E. A. Newell Arber gave a preliminary note on the fossil floras of the South Staffordshire Coalfield, which include both petrifications and impressions, and expressed the hope that in course of time it will be possible to trace the floras systematically from the lowest to the highest beds of the Coal Measures of this coalfield.

In a paper on the correlation of the Leicestershire Coalfield, Mr. R. D. Vernon stated that it had been found impossible to use either the sandstones or the seams of coal in the correlation even of the eastern and western portions of the Leicestershire Coalfield itself, and that fossil plants had also proved of relatively little value, and the fresh-water lamellibranchiata were equally unsatisfactory. For these reasons a search was made for marine beds. The thickest marine bed occurs about 260 yards above the Moira Main coal, and its outcrop has been mapped on the it is comparable with the Gin Mine marine bed of that in stratigraphical position and in faunal contents it is comparable with the Gine Mine marine bed of North Staffs, the Mansfield marine bed of the Yorkshire and Nottinghamshire field, and the Pennystone Ironstone marine bed of Coalbrookdale, and therefore serves as a means of correlating the Measures of Leicestershire with those of neighbouring areas.

On systems of folding in the Palæozoic and newer rocks, by G. Barrow. The author is of opinion that many so-called systems of folding are due to series of resisting masses with parallel margins, and cites as examples the great lenticular masses of thermally altered rocks of the Highlands.

In a paper on the Harlow Boulder Clay and its place in the glacial sequence of eastern England, Dr. A. Irving dealt with the sequence of the various deposits of Pleistocene age in the eastern counties of England.

The discovery of Lower Carboniferous Grits at Lye, in South Staffordshire, was recorded by Mr. W. W. King and Mr. W. J. Lewis.

Mr. E. A. Walford read a paper on some of the basement beds of the Great Oolite and the Crinoid beds, and suggested the following subdivision of the Great Oolite :—

UPPER GREAT OOLITE.—(1) *Terebratula maxillata* beds; (2) *Calcaire à Echinodermes*.

LOWER GREAT OOLITE.—(1) Striped Limestones; (2) *Rhynchonella concinna* beds; (3) Stonesfield Slate.

SUB-BATHONIAN.—(1) Striped Limestone and Crinoid beds; (2) Neæran series; (3) Striped Crinoid Marls; (4) Chipping Norton Limestones.

Mr. A. R. Horwood directed attention to the value of a knowledge of the rock soil distribution of plants in tracing geological boundaries, and pointed out the consequent importance of the new ecological surveys to the geologist.

The geology of the district between Abereiddy Bay and Pen Caer, Pembrokeshire, formed the subject of a paper presented by Dr. A. H. Cox and Prof. O. T. Jones, in which it was shown that not only Llandeilo and Bala rocks, as previously supposed, but Arenig and even Cambrian rocks form large areas on the coast. The authors propose to map the area in detail.

"The Relation of the Rhiwlas and Bala Limestones at Bala," by Dr. Gertrude L. Elles. The Rhiwlas Limestone is an impersistent limestone at the base of the Hirnant Series, and is found only in the northern part of the area. The Bala Limestone is not developed as a calcareous bed in the northern part of the area. The true relation of these horizons to each other is seen at Gelli Grin, where the Bala Limestone at its maximum thickness is overlain by light-coloured, pasty mudstones, containing a typical Rhiwlas Limestone fauna.

The work of excavation of critical sections in the Cambrian rocks of Shropshire has been continued, and has furnished palæontological proofs of the prolongation of the Lower and Middle Cambrian rocks of Comley into the Cwms area to the south, and a description of excavations Nos. 53, 54, 55, and 56 formed the subject-matter of a communication by Mr. E. S. Cobbold, who has been carrying on the work.

Dr. A. Irving furnished a contribution to the much-discussed question of "Flint and its Genesis." Silicification of calcareous fossils can be understood as a "mass-reaction" of the alkaline silicates in the presence of a large excess of water :—

$$nH_2O + CaCO_3 + K_2SiO_3 = \underset{\text{(dissolved)}}{K_2CO_3 + Ca(OH)_2} + \underset{\text{(precipitated)}}{SiO_2} + (n-1)H_2O.$$

Plant petrifactions in chert and their bearing on the origin of fresh-water cherts was discussed by Dr. Marie C. Stopes, who directed attention to the recent "sapropel" observed by Potonie, and the likeness it has to the débris in certain cherts from Asia Minor, and concluded that the chert may be taken as practically pure petrified "sapronel."

Dr. Vaughan Cornish directed attention to the conditions which govern the transport and accumulation of detritus by wind and water.

In a communication on the shelly and graptolitic faunas of the British Ordovician, Dr. Gertrude L. Elles showed that there are two main types of "shelly" faunas of Ordovician age in the British Isles, and that each of these can be further subdivided into a number of subfaunas, which can be correlated by reference to associated graptolite-bearing beds. The main shelly types were described as (*a*) Asaphid-Trinucleid-Calymenid fauna; (*b*) Cheirurid-Lichad-Encrinurid fauna. It was suggested that fauna (*b*) is an exotic fauna, possibly southern in origin, which migrated into the British area. Becoming early established in south Scotland, it soon spread west into Ireland, but did not dominate the whole British area until Ashgillian times. Correlation tables were given showing the relations of the various faunas of the groups (*a*) and (*b*) to the graptolite zones of the series.

"A First Revision of the British Ordovician Brachiopoda, by Clara E. Sylvester. The author gave a summary of the present stage of her researches among the British Ordovician Brachiopoda, and presented a table of the known species, with their range and geological and geographical distribution. The species in each genus were grouped around well-known forms selected as types.

Mr. W. D. Matthew gave a paper on discoveries in the American Eocene.

In further notes on Palæoxyris and other allied fossils, with special reference to some new features found in Vetacapsula, Mr. L. Moysey directed attention to several features which had been found in certain new material collected since the publication of his paper in the Quart. Journ. Geol. Soc., vol. lxvi., 1910.

Mr. Frank Raw gave a paper on the occurrence of a wind-worn rock surface at Lilleshall Hill, Salop.

The author directed attention to certain surfaces of Uriconian rocks which have been ground smooth, and where hardest highly polished.

Mr. V. C. Illing directed attention to certain recent discoveries in the Stockingford Shales near Nuneaton, which tend to show that the Cambrian succession in that area is almost, if not quite, complete. The author correlates the beds as follows :—

Merevale Shales.	Lower Tremadoc.
Oldbury Shales	Dolgelly. Ffestiniog. Maentwrog. Menevian.
Upper Purley Shales Middle Purley Shales	Menevian?
Lower Purley Shales Hartshill Quartzite	Taconian.

The same author, under the title of "Notes on certain Trilobites found in the Stockingford Shales," described numerous forms, representing young stages in the development of certain trilobite genera, including Liostracus, Holocephalina, and Paradoxides, together with certain new forms of Agnostus.

The classification of igneous rocks formed the subject of a communication by Dr. H. Warth. The classification proposed was a chemical one, and was based, not upon the proportions of individual bases, but upon the respective sums of bases of equal valency. Tables and diagrams were shown in illustration of the paper.

Copper in the sandstones of Exmouth was recorded by Mr. C. Carus-Wilson. Copper-carbonate was found in certain sandstones between the Exmouth golf links and the High Lands of Orcombe. Its presence is due to copper pyrites, which is one of the constituents of the sandstone, and is undergoing decomposition.

Dr. A. Hubert Cox and Prof. O. T. Jones described several occurrences of pillow lavas in Wales. The lavas were in some cases associated with chert and jasper.

Dr. A. Hubert Cox described certain igneous rocks of Ordovician age, and suggested that the Ordovician igneous rocks would appear to afford a favourable ground for ascertaining whether the connection between rock-types and types of earth-movement holds good to a greater extent than has been hitherto suggested, and we may perhaps expect that further research will show some constant difference between the facies of the igneous rocks in areas where subsidence was continuous, and the facies in areas where subsidence was interrupted by uplift.

Prof. W. S. Boulton described and exhibited a new form of machine for cutting thin sections of rocks. The machine is electrically-driven, and can be connected with any ordinary incandescent lamp-carrier on the house circuit. A special arrangement for automatic lubrication of the cutting edge is provided, and also a new device for arming the disc.

Mr. C. H. Cunnington read a paper on the Carboniferous Limestone at the head of the Vale of Neath, South Wales.

A special series of Excursions was organised by Prof. Lapworth, Prof. Boulton, and Mr. Frank Raw, and many places of geological interest were thus thrown open to the members. The excursions included the Licky Hills and the Clents, under the leadership of Prof. Lapworth; Nuneaton and Atherstone, Prof. Watts and Mr. Illing; The Wrekin, Prof. W. S. Boulton; and Witley and the Lutley Valley, Mr. H. Kay and Mr. W. H. Foxall. There was also an excursion to Cheltenham in conjunction with the Cheltenham Natural Science Society, under the leadership of Mr. L. Richardson.

At the conclusion of the meeting, Prof. Lapworth conducted a three days' excursion into South Shropshire, and a number of members availed themselves of the opportunity of visiting this classic district under the guidance of one who has done so much to elucidate its complex structure and the relationship of its older sediments.

A. R. D.

PALÆOBOTANY: ITS PAST AND ITS FUTURE.[1]

PALÆOBOTANY has already passed through three main phases of its development: the first, when fossil plants were supposed to be the spontaneous ornamentations of stones by an exuberant nature which blindly disported itself. The second, when they were realised as being the remains of extinct life, but were described without the light of a fundamental and unifying hypothesis; and the third, when a scientific knowledge of their structure made comparison with recent plants possible, and it was realised that they threw light on the evolution both of the living plants and the existing continents. In this phase we are now at work.

Even at a time when the true nature of animal fossils was realised, and their occurrence causing much discussion, references to plants were few. John Ray wrote in 1693 :—"Yet I must not dissemble, that there is a Phænomen in nature, which doth somewhat puzzle me to reconcile with the prudence observable in all its works, and seems strongly to prove, that nature doth sometimes *ludere*, and delineate Figures, for no other end but for the Ornamentation of some Stones, to entertain and gratifie our Curiositie or exercise our Wits. That is, those elegant Impressione of the Leaves of Plants upon Cole-Slate."

The lecturer read quotations from a number of little-known books written between 1693 and 1781, illustrating the importance of fossil plants to those authors who took the flood as a fact, and were puzzled to account for the existence of plants at all on the earth—for only the animals had been preserved in Noah's Ark. Among pioneers of Palæobotany, it is interesting to discover the mystic Swedenborg, who published the first plates of fossil plants in Sweden, a country now famous in palæobotany through Prof. Nathorst's work.

At the beginning of the nineteenth century, palæobotany suddenly became scientific. The works of Brongniart, Sternberg, Schlotheim, and others created a new epoch in the science. In 1828 Sprengel described silicified fern stems from their anatomical structure. In 1833 Witham published his book on "The Internal Structure of Fossil Vegetables," and this was shortly followed by a large work giving beautiful drawings of the anatomy of Psaronius and other fossils by Corda.

As a forerunner of the newer type of work which crystallised round Williamson, one may here place Sir Joseph Hooker, who was much interested in and published several valuable papers on the structure of fossil plants, and who held from 1846 to 1848 the official post of botanist to the Geological Survey. The post has lapsed for all these years, and to-day, when the surveys of other civilised countries have their official palæobotanists, it would be interesting to know why England, the first to originate the post, and the premier coal-producing country in the world, should be minus so valuable a servant. Concerning the extreme value and originality of Prof. Williamson's work, little need be said. He may justly

[1] From an inaugural lecture delivered at University College (University of London) on October 17, by Dr. Marie C. Stopes.

be described as the father of botanical palæobotany. It was Williamson who, in face of the opposition of every living botanist of his day, propounded the fact that the lower vascular plants could develop secondary wood without, as the French school of palæobotanists maintained, thereby qualifying for inclusion among the Angiosperms. Writing on Williamson's work on Cambium, Solms Laubach said:—"This is a general botanical result of the greatest importance and the widest bearing. In this conclusion palæontology has, for the first time, spoken the decisive word in a purely botanical question."

The anatomical structure of plants was also receiving attention at the hands of other brilliant men, about the same time, chief among whom were Renault and Solms Laubach.

The more geological side of palæobotany was at that time growing rapidly as a result of the researches of Saporta, Heer, Ettingshausen, Lesquereux, and others. Heer in particular was doing work of world-wide fame in his discoveries of Arctic floras which indicated a once warmer climate for those now frozen zones. Nevertheless to some of Heer's work, and to many monographs published at the end of the nineteenth century, one might apply the following words, which, curiously enough, were published a hundred years before such work appeared. In 1784 Francis-Xavier Burtin said:—"Malheureusement ceux qui découvrent un fossile, s'empressent trop de le nommer, et le mot je *l'ignore* paroit avoir été de tout temps dur à prononcer. De là cette quantité de noms absurdes, dont la science oryctologique parvient si difficultment à se débarrasser."

To-day palæobotany has three sides; or rather, the new science slowly reaching out from the shelter of its step-parents botany and geology, is already a growth with three main branches, each of which bears fruits of value to three sections of the community.

First, to botanists. Reference has been made to some of the recent work of palæobotany as being indispensable to the science of modern botany. This is now recognised by every leading botanist, and Sir Joseph Hooker in a letter to Dr. Scott in 1906 wrote of our "knowledge of botany as it advances by strides under a study of its fossil representatives." From the student of the fossils, one learns not only of whole genera, and even families of extinct plants, which help us to comprehend the relationships of existing types, but often the fossils exhibit complexities and novelties of character which not the most vivid imagination could have foreseen. For instance, what modern botanist, even in a delirious dream, could have conceived of a cone for the Lower Carboniferous Pteridophytes so complex as Cheirostrobus, the demonstration of the actual structure of which we owe to Dr. Scott? Then the existence in the past of the Pteridosperms, demonstrated by Prof. Oliver and Dr. Scott, is of profound importance to all botanists.

The modern botanist's conceptions of morphology, his definitions even of an organ like the seed, have undergone profound modification through the introduction of ideas based on fossils. *Only from the fossils can we learn the actual facts of evolution.* Connecting the botanist with the geologist is the plant-geographer. The history of Ginkgo, now an isolated species only found native in Japan and eastern China, but in Tertiary to Oolitic times widely distributed over Europe and America, illustrates with a single instance, the importance of the palæobotanical record for those who deal with the distribution of modern plants.

Asa Gray said:—"Fossil plants are the thermometers of the ages, by which climatic extremes and climate in general through long periods are best measured"; and Charles Darwin, in 1881, wrote to Hooker:—"The extreme importance of the Arctic fossil plants is self-evident."

Through the palæogeographer we come to the geologist. To what extent is he indebted to palæobotany? In this country, it has been so arranged by nature that there are no immense tracts of land composed of strata in which the only fossils are plants; had there been, possibly that survey post held by Hooker in 1846 would not have lapsed. If our geologists think they can get along without palæobotanists, let us hear what the Americans have to say.

There are twelve palæontologists altogether in the United States Geological Survey, and of these four are palæobotanists. Take the record of one of these geological palæobotanists, Dr. Knowlton; he says:—"For the past five years I have annually studied and reported on from 500 to 700 collections, each of which embraced from one to hundreds of individuals, and with them have helped the geologists to fix perhaps fifty horizons in a dozen states."

Now let us turn to the third branch of my science. This is the practical side, and deals specially with coal-mining. In their rough and ready way, miners have "muddled along" without much help from palæobotanists. But with a collaboration between the two great advantages to both would accrue, and are to be looked for in the future. Palæobotanical information, to be of any value to the miner, must be very detailed and accurate. It represents the ultimate refinement of the stratigraphical work just mentioned as being the province of geological palæobotany. Fine and accurate zoning by plants has already been successfully carried on, however, particularly in France, where Prof. Zeiller, of Paris, or M. Grand' Eury, is called in consultation before most mining operations of importance are undertaken. Palæobotany is an intricate and independent science, which is now much vaster than is realised by more than a few people. To illustrate the enormous mass of detail with which a conscientious palæobotanist has to cope, it is only necessary to turn to Dr. Jongmans's *résumé* of the publications for the year on the subject. It is 569 pages long, and on each page are, on an average, twenty-one entries. But this invaluable work has only been published for the last three years. For everything before that we have no centralisation of results.

What will the palæobotanist of the future demand?

That in at least *one* institution in each civilised country there shall be a recognition of his science and adequate accommodation for it. This institution would form the headquarters, the centralising bureau, for all the branches of work in which the individual palæobotanists may be specialising whether as geological palæobotanists, botanical palæobotanists, or practical miners. In this central department should be kept standardised collections of fossil plants. In this central department also should be available herbariums and immense series of sections of modern plants with which to compare the fossils while working on the botanical elucidation of their structure. As things are to-day in any new branch of palæobotany, the modern botanists do not provide exactly the kind of data wanted for comparison by the palæobotanist. This is noticeably the case, for instance, in the study of early fossil Angiosperms. No modern botanist can show us the preparations of living Angiosperms that are essential for our researches.

Then, too, in this central department of the science would be collected together, not only all the literature on palæobotany, but this literature would all be indexed, analysed, and made available on several series of card catalogues. The work done by Dr. Jongmans for the last three years must be done for the last 150 years, and put in the handiest form for reference, which is, of course, a card catalogue. Then there must be a complete card index of all the names ever given to fossil plants. At present, most palæobotanists, all indeed, save a very few, tend to despise questions of nomenclature, but our science is in a very bad way owing to the immense numbers of names given on insufficient or wrong grounds. One cannot emphasise too strongly the urgent necessity for palæobotanists to reduce order from the chaos of their present nomenclature, and this can only be done by some centralising institution or committee, who are sufficiently grounded in the science to realise the special needs of palæobotany.

Beyond all this it must not be forgotten that the collections of fossil plants at present made are trivial in comparison with those which will have to be made from all parts of the earth before we can completely unravel the histories of the ancient continents, solve questions of past climates, restore the details of innumerable extinct floras, and reconstruct the tree of plant evolution through the ages.

In spite of all the discoveries of palæobotany immense problems still lie unsolved. Darwin said, in a letter to Hooker, "The rapid development, so far as we can judge, of all the higher plants within recent geological times is an abominable mystery." To-day it is an abominable mystery still, and an abominable mystery it will remain until palæobotany is recognised as an independent science, and housed, endowed, and equipped so that she has the tools she needs for her work.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Board of Agricultural Studies reports that the number of students receiving instruction in the school of agriculture is 320. The number of senior students, exclusive of members of the staff, engaged in research during the past year was nineteen. In view of the large number of research students working in the school of agriculture, the University has constituted a degree committee of the Board of Agricultural Studies, which has already recommended one research student for the B.A. degree. The extension of the school of agriculture is now practically completed, and will be fully occupied during the present term by the transference of most of the research work from the original building. In this way more laboratory accommodation is provided for teaching.

Under a general scheme for research work in forestry, the Board of Agriculture in July, 1912, offered a grant to the University to enable investigations to be undertaken on questions relating to the structure of timber, &c. The forestry committee appointed Mr. Burdon as investigator, and Mr. A. P. Long as assistant-investigator. The work commenced on January 1, and rapid progress has been made. In addition to two interim "progress reports," a bulletin, the first of a series, on "Scots Pine in Great Britain," has already been issued by the University Press, while a second bulletin is now in the press. In addition to field investigations of the nature dealt with in the bulletin issued, several investigations and experiments of a different nature have also been started. In April last, the Great Northern Railway Company asked the investigator to undertake certain inquiries relative to the preservation of sleepers, and their subsequent immunity from fungal attacks. An experiment with some thirty sleepers is now in progress. Under the grant of 500*l.* a year from the Board of Agriculture for advisory work the committee has, in accordance with the conditions of the grant, appointed Mr. C. Hankins, who took up duties on April 1 of this year. There has already been a large demand for advice on the management of woodlands, from landowners in the eastern counties.

By the will of the late Mr. G. W. Palmer, of Reading, a bequest of 10,000*l.* is made to University College, Reading.

Mr. Alexander McKenzie, head of the chemistry department of Birkbeck College, London, has been appointed professor of chemistry in University College, Dundee, in succession to the late Prof. Hugh Marshall.

It is announced that a large bequest, stated to be approximately 250,000*l.*, is made in the will of the late Mr. W. Gibson, of London and Belfast, to institute a scheme for providing sons of farmers of counties Down and Antrim with educational advantages. No details of the scheme are yet available.

A Reuter message from Cape Town on November 14 announces that Prof. John Perry, F.R.S., has been appointed a member of the University Commission which is to investigate matters connected with higher education and to consider the conditions under which the Wernher and Beit donations and bequests for the purposes of the proposed University of South Africa may best be utilised. The other members of the Commission are Sir Perceval M. Laurence, formerly Judge President of the Supreme Court of South Africa, who is the chairman, ex-Justice Melius de Villiers, and the Rev. Mr. Bosman. Prof. Perry's views upon university education were stated by him clearly in an address delivered at Oxford just ten years ago and published in full in Nature of December 31, 1903 (vol. lxix., p. 207); and in many papers and addresses he has described the useful functions of great schools of science and technology.

The annual general meeting of the Association of teachers in Technical Institutions was held on November 15, at St. Bride's Foundation Institute, London, E.C., when the retiring president, Mr. P. Coleman, was in the chair. The annual report of the council was adopted; it shows that the association has continued to progress in strength and influence, and has maintained the reputation it has earned for energy and activity. The increase in membership continues to be satisfactory, and is now about 1200. Two new branches were formed during the year, namely the Leicester Branch and the South of Ireland Branch. National councils have now been formed in Scotland and Ireland, and the organisation and development of these will engage the attention of the council during the present session. In the early part of the year the council had under consideration the situation which has been created by the abandonment of certain examinations of the Board of Education and the general adoption of internal examinations. The council finally determined to urge local authorities to form advisory boards in various localities for the purpose of assisting in the coordination of examinations within a district. The council feels that the present position with regard to the salaries of technical teachers is unsatisfactory. Although the cost of living has increased considerably, the salaries of teachers have not appreciably increased. The council hopes that in a very short time it will be able to report that important steps have been taken to obtain a satisfactory solution of this matter. The desire for cooperation between the different associations of teachers continues to increase, and this association, as representing technical teachers, has, during the past year, lost no opportunity of joint action with other professional bodies. Mr. P. Abbott, Regent

Street Polytechnic, was elected president, Mr. J. Paley Yorke honorary secretary, and Mr. C. Harrap honorary treasurer.

On November 15 Dr. David Starr Jordan, president of the Leland Stanford Junior University, delivered a lecture at Birkbeck College on the American university. He said that the words of Emerson, "America means opportunity," supplies the basal idea of the American university. American university institutions are not intended to maintain any kind of tradition or system; they are intended to meet the people's needs. What is best for one may not be best for another, and it is not for any educational board to say that this study is more valuable than that. It is for the student to find out which things are worth most to him. Scholarship, he said, depends on the thoroughness of our knowledge in its relation to the affairs of human life. In tracing the development of the universities in the United States, Dr. Jordan said that about 1868 the Act was passed which allowed for the gift to every State of a large amount of land on condition that a university was established, which was to teach, among other subjects, agriculture and the mechanic arts, and that brought engineering and agriculture into the very centre of their university system. The work of the university is to bring scholars together, and if he were to offer a word to London upon the university question he would say: "Above everything bring together all the fragments that are scattered over the City." The university is not the place for men who neglect work, and in the United States they are moving more and more towards testing a man's work as he goes on and sending him home to think about it if it was unsatisfactory. Dr. Jordan himself once sent away 131 men in one day. American authorities have generally agreed that prizes do not help scholarship, and most American institutions have discarded honours for the same reason. He thought, he said, that the abuse of fellowships and scholarships has been greater on the whole than the good results. In most American universities, if those under the old influences are excepted, men and women are admitted on the same terms, and nothing will induce the Western institutions to change that system. One result of reaching out for all kinds of talent is an enormous increase of students. In California, where the population numbers 2,000,000, there are 8000 university students.

SOCIETIES AND ACADEMIES.

LONDON

Royal Society, November 13.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir William **Crookes**: The preparation of eye-preserving glass for spectacles (see p. 356).—Prof. A. W. **Porter**: An inversion point for liquid carbon dioxide in regard to the Joule-Thomson effect.—Prof. A. W. **Porter** and Dr. F. W. **Edridge-Green**. Negative after-images and successive contrast with pure spectral colours. This paper is a rejoinder to the criticisms made by Prof. Burch to a previous paper. The authors have repeated their experiments, taking the most minute precautions to avoid all stray light, with the same results as before. The most important result is that a negative after-image of an approximately complementary colour is obtained in the total absence of stimuli which would cause such colour.—Prof. O. W. **Richardson**: The positive ions from hot metals.—G. W. **Walker**: The diurnal variation of terrestrial magnetism. The paper deals with observational data with regard to the diurnal variation of terrestrial magnetism collected from nine observatories. The data are presented in terms of the Fourier coefficients of the 24-hour and 12-hour terms for the geographical components to north, west, and vertical (downwards). It is noted that the data give strong support to Dr. Schuster's formulæ (Phil. Trans., 1908) for the magnetic potential of diurnal variation as derived from the west component; but the magnetic potential so determined does not give the proper numerical values for the north component as observed. The data for vertical force are shown to be in general agreement with Schuster's conclusion that the primary source of variation is of epigene origin.—G. W. **Walker**: A suggestion as to the origin of black-body radiation. The paper first shows that a function of dynamical form can represent the data with regard to radiation quite as well as the formula proposed by Planck.

Royal Anthropological Institute, November 4.—Prof. Arthur Keith, F.R.S., in the chair.—J. Reid **Moir**: The striation of flint surfaces. The paper dealt with the scratches to be observed upon flints found upon the present land surface. Flint was shown to be a material of variable hardness, the black unchanged variety being the most resistant. Specimens from the surface which had been "patinated" were much softer, and it was shown how these can be scratched by passing a flint point over their surfaces under pressure. It was also demonstrated that a *hardened steel* point will also have this effect. The depth and nature of a scratch depend largely upon the hardness of the surface to be scratched. Examples of scratched glass found upon the surface of the fields were exhibited, and the scratches upon them shown to be of various kinds and similar to those developed upon surface flints. The specimens of scratched glass demonstrated that certain movements, such as would be brought into play by agricultural operations on the present land surface, were sufficient to imprint scratches upon scratchable objects lying on that surface, and as it has been demonstrated that some flints can be scratched by steel it seems probable that certain of the scratches seen upon surface flints can be assigned to the same cause. The "weathering out" of scratches upon flints was next dealt with. It was shown that when a moving point passed over a flint under pressure the area upon which the point impinged was shattered, and small plates of flint formed along the line of movement. These plates of flint in time weather out and leave a clean-cut groove behind. If the theory of the weathering out of scratches was correct, then what in many cases had been looked upon as deep glacial stria might possibly be simply weathered-out "shattered" scratches, the initial stage of which would not require any very great pressure to produce.

Geological Society, November 5.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—J. A. **Douglas**: Geological sections through the Andes of Peru and Bolivia. The geological structure is dealt with of the South American Andes, as illustrated by a horizontal section from the port of Arica in the north of Chile across the "Cordilleras" to the forested region of the Amazon slopes, following the route of the Arica-La Paz railway. The general physiography of the Peruvian Andes and the topographical features of the country traversed by the railway are discussed. Its geological structure is described under three headings:—(1) The Mesozoic sediments of the coastal region with their contemporaneous igneous rocks; (2) the volcanic rocks of the Mauri River, the Mesozoic and Palæozoic sediments of the "Altaplanicie" and the Titicaca district; (3) The Palæozoic rocks and granitic core of the eastern Cordillera and the Amazon slopes. The Mesozoic stratified rocks are well exposed in the "Morro de

Arica," where fossils occur which indicate an Upper Jurassic (Callovian) age. They are interbedded with thick sheets of basic enstatite-andesite. The erosion of the river-valleys that has brought to light the Jurassic sediments has also laid bare the underlying plutonic mass of granodiorite, which may be regarded as the deep-seated core of the western "Cordillera." The western Cordillera is essentially a volcanic range. The enormous amount of volcanic material emitted has almost completely concealed the underlying rocks. The lavas can be resolved into three main groups, characterised by their dominant ferromagnesian mineral, succeeding one another in age according to a law of increasing basicity. The "Altaplanicie," is almost entirely covered by horizontal sheets of volcanic ash, tuff, and pumiceous lava, described as the Mauri Volcanic Series. The occurrence in an interbedded layer of gravel, of a fragment of a jaw of "Nesodon," almost identical with specimens from the Miocene beds of Santa Cruz, affords a clue for an estimation of their age. They are overlain on the east by gravel-deposits of the Desaguadero River, the highest terrace of which was found to contain remains of Mastodon, Megatherium, Scelidotherium, and other Pleistocene vertebrates. From beneath these superficial deposits crops out a series of unfossiliferous red sandstones and conglomerates. These are divided into two groups—a younger series of Cretaceous age resting with pseudoconformity on an older Permo-Carboniferous group. The Carboniferous formation is nowhere exposed along the line of section. The eastern Cordillera is composed chiefly of steeply-dipping Devonian slates and quartzites.

Linnean Society, November 6.—Prof. E. B. Poulton, F.R.S., president, in the chair.—H. Hamshaw **Thomas** and Miss Nellie **Bancroft**: The cuticles of some recent and fossil Cycadean fronds. The investigation was undertaken with the view of determining the probable relationships of the modern group to the Mesozoic Cycadophyta.—Prof. W. A. **Herdman**: Spolia Runiana II. Results of the past season's dredging. The author described the course taken by the yacht off the west coast of Scotland, and showed a long series of slides displaying the scenery and bird-life of the unfrequented regions visited.

Mineralogical Society, November 11.—Anniversary meeting.—Dr. A. E. H. Tutton, F.R.S., president, in the chair.—A. **Hutchinson** and A. M. **MacGregor**: A crystalline basic copper phosphate from Rhodesia. The mineral occurs at the Bwana M'Kubwa copper mines as a crust of minute, brilliant, peacock-blue, orthorhombic crystals, associated with malachite. Axial ratios $a:b:c=0{\cdot}394:1:1{\cdot}01$; forms 110, 011; hardness 4–5; specific gravity 4·1. Chemical composition, determined by an analysis of a small quantity of carefully selected material, approximates to the formula $2Cu_3(PO_4)_2.7Cu(OH)_2$; no water is lost on heating to 190°. Although it has much the same composition as some minerals included in the pseudomalachite family, it differs widely in its physical characters from dihydrite, the only well-defined crystalline member of the group, and is probably a new species.—Dr. G. T. **Prior**: The meteoric stone of Wittekrantz, South Africa. The stone, which fell on December 9, 1880, at the farm, Wittekrantz, Beaufort West, Cape Colony, is slightly chondritic, and consists of the usual aggregate of olivine and bronzite, with particles of nickeliferous iron and troilite. In chemical and mineral composition it is very similar to the Baroti meteorite previously described.—Dr. G. T. **Prior**: The remarkable similarity in chemical and mineral composition of chondritic meteoric stones. The close similarity presented by most chondritic meteoric stones, although generally recognised, has to some extent been obscured by the unduly elaborate classifications which have been devised. A review of the quantitative mineral composition of forty-two chondritic stones and a critical examination of the published analyses of others lead to the conclusion that almost all those at present known are, except for some variation in the amount of nickeliferous iron, practically identical in chemical and mineral composition, the identity extending even to the chemical composition of the individual constituents. They approximate to the type with the following percentage mineral composition:—Nickel-iron ($Fe:Ni=10$), 9; troilite, 6; olivine ($Mg:Fe=3$), 44; bronzite ($Mg:Fe=4$), 30; felspar, 10; chromite, &c., 1.—Arthur **Russell**: Notes on the minerals occurring in the neighbourhood of Meldon, near Okehampton, Devonshire. The principal species are datolite, in crystals sometimes 2½ cm. in length, sea-green in colour, and nearly transparent, polysynthetically developed, and showing a cleavage parallel to 001; apophyllite, in three types—square, tabular, and pyramidal; pyrrhotite, in thin hexagonal plates; tourmaline, in black, brown, green, blue, and pink crystals, sometimes zoned; garnet, in colourless cubo-dodecahedra, and trapezohedra, sometimes including wollastonite hairs; wollastonite, abundantly in pure white, fibrous masses.—J. B. **Scrivenor**: A calcium-iron-garnet from China. It is interesting on account of its unusually easy solubility in hydrochloric acid without ignition.

Mathematical Society, November 13.—G. T. **Bennett**: The skew-isogram mechanism.—G. H. **Hardy** and J. E. **Littlewood**: Tauberian theorems concerning power series the coefficients of which are positive.—G. H. **Hardy**: Lambert's theorem.—J. E. **Campbell**: (1) The connection between surfaces the lines of curvature of which are spherical and surfaces the inflectional tangents of which belong to linear complexes. (2) Surfaces the systems of inflectional tangents of which belong to systems of linear complexes.—W. H. **Young**: Integration with respect to a function of bounded variation.—W. W. **Johnson**: The computation of Cotes's numbers, and their values up to $n=20$.—S. G. **Soal**: Some ruler constructions for the covariants of a binary quantic.—T. C. **Lewis**: Analogues of orthocentric tetrahedra in higher space.

Paris.

Academy of Sciences, November 10.—M. F. Guyon in the chair.—Emile **Picard**: Remarks concerning an integral equation considered by M. Charlier.—H. **Deslandres** and L. **d'Azambuja**: The action of a magnetic field on the ultra-violet band spectrum of water vapour. A new property of the regular series of lines forming the band. The third group of the nitrogen bands shows the Zeeman effect; under similar conditions the water vapour band is not doubled by the magnetic field, but all the lines constituting the band are displaced.—Armand **Gautier**: Fluorine as a constant element in the emanations from the earth's crust. Fluorine (probably as hydrofluoric acid) has been detected and estimated in the gases from a fumerolle at Vesuvius, in the proportion of about one part in 10,000. Fluorine has also been found in the fumerolles of Tuscany.—E. **Jungfleisch** and Ph. **Landrieu**: Researches on the acid salts of dibasic acids. The dextrorotatory camphorates: the potassium camphorates.—C. V. L. **Charlier**: Terrestrial refraction and the constitution of the atmosphere.—M. **Fessenkoff**: The equatorial acceleration of the sun.—MM. **Chipart** and **Liénard**: The sign of the real part of the roots of an algebraic equation.—Georges **Pólya**: An algorithm always convergent to obtain polynomials with the best approximation of Tchebychef for any continuous function.—E. **Goursat**: Some singular integral equations.—R. **Boulouch**: Homographical relations between systems of centred spherical dioptres. Singular stigmatic points.—Emile **Baud**: Relation between the heat of formation of binary liquid mixtures and their composition. For mixtures of *cyclo*hexane and ethylene bromide the relation $q = kx(1-x)$ is shown to hold good, in which q is the quantity of heat evolved, x and $(1-x)$ are the fractions of the gram-molecule of each constituent for a gram-molecule of the mixture. k varies only from 1·30 to 1·35.—L. C. **Maillard**: The origin of the cyclic bases of coal tar. Amino-acids combine with sugars giving humus bodies which yield pyridine bases on dry distillation. These facts are applied to the formation of coal and to explain the products of its pyrogenic decomposition.—Marcel **Sommelet**: A mode of decomposition of the halogen alkylates of hexamethylene-tetramine. An aqueous solution of the chlorbenzylate of hexamethylene-tetramine when boiled gives benzaldehyde as the main product of its decomposition. The homologous toluic aldehydes are formed in a similar manner. The course of the reaction cannot be readily followed.—C. **Gaudefroy**: The dehydration figures of potassium oxalate.—G. **André**: The displacement of potassium contained in certain felspathic rocks by some substances employed as manure. Various salts, triturated in aqueous solution with felspar, bring into solution notably larger quantities of potassium than would be obtained with water alone, ammonium sulphate, and calcium acid phosphate producing the greatest effect.—A. **Maublanc** and E. **Rangel**: *Stilbum flavidum*, a parasite of the coffee plant, and its place in classification.—G. **Barthelat**: The fruit of Mesembryanthemum and its dehiscence.—P. **Chaussé**: The determination of the minimum infectious dose in tuberculosis by inhalation.—C. **Levaditi**: Presence of the treponeme in the blood in general paralysis. The living organism was definitely proved to be circulating in the blood of patients suffering from general paralysis. The blood in these cases gave a positive Wassermann reaction.—Y. **Manouélian**: The existence of Negri's corpuscles in the nerve ganglia of the salivary glands in animals suffering from rabies. Sections of the salivary glands showed large numbers of Negri's corpuscles in the cytoplasm of the nerve cells only; no other constituent of these glands showed the corpuscles.—Maxime **Ménard**: A certain means of avoiding Röntgen-ray burns. A description of special screens and gauntlets, together with a proof of the real immunity from X-ray burns obtained by their use.—M. **Dantan**: The fecundity of *Ostrea edulis*.—A. **Trillat** and M. **Fouassier**: The conditions of transport of micro-organisms by the air. Experiments leading to the conclusion that micro-organisms can be transported by air without the intervention of mechanical projection. This view is opposed to ideas currently held.—Charles **Lepierre**: The uselessness of zinc for the culture of *Aspergillus niger*. The mould grows and reaches a normal weight when zinc is absent from the culture medium.—J. **Stoklasa**: The influence of radio-activity on nitrogen fixing micro-organisms, or on those transforming nitrogenous materials.—Sabba **Stefanescu**: The ramification of the dental tubercles of the molars of Elephas, Stegodon, and Mastodon.

BOOKS RECEIVED.

Die Wissenschaft. Band 48. Die Entwicklung des Temperaturbegriffs im Lauffe der Zeiten. By K. Meyer. Uebersetzt aus dem Dänischen by I. Kolde. Pp. 160. Band 49. Das Leuchten der Gase und Dämpfe. By Dr. H. Konen. Pp. xiv+384. (Braunschweig: F. Vieweg und Sohn.) 4 and 12.50 marks respectively.

Lehrbuch der Meteorologie. By Dr. J. Hann. Unter Mitwirkung von Prof. R. Süring. 3 Auflage. Lief. 1. (Leipzig: C. H. Tauchnitz.) 3.60 marks.

Memoirs of the Geological Survey, Scotland. The Geology of the Fannich Mountains and the Country around Upper Loch Maree and Strath Broom. (Explanation of Sheet 92.) By B. N. Peach and others, and Petrological Notes by Dr. J. J. H. Teall. Pp. 127+vi plates. Also Sheet 92. (London: H.M.S.O.; E. Stanford, Ltd.) 2*s.* 6*d.* each.

Elemente der exakten Erblichkeitslehre mit Grundzügen der biologischen Variationsstatistik. By Dr. W. Johannsen. Zweite Deutsche Ausgabe in 30 Vorlesungen. Pp xi+723. (Jena: G. Fischer.) 13 marks.

The Holiday Nature-Book. By S. N. Sedgwick. Pp. 355. (London: C. H. Kelly.) 3*s.* 6*d.*

The Courtship of Animals. By W. P. Pycraft. Pp. xvi+318+40 plates. (London: Hutchinson and Co.) 6*s.* net.

Farm Gas Engines. By Prof. C. F. Hirshfeld and T. C. Ulbricht. Pp. vii+239. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6*s.* 6*d.* net.

Underground Waters for Commercial Purposes. By Dr. F. L. Rector. Pp. iv+98. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 4*s.* 6*d.* net.

The Government of Man: an Introduction to Ethics and Politics. By G. S. Brett. Pp. xiv+318. (London G. Bell and Sons, Ltd.) 3*s.* 6*d.* net.

British and Colonial Dairying for School, Farm, and Factory. By G. S. Thomson. Pp. xi+464. (London: Crosby Lockwood and Son.) 5*s.*

Transactions of the Rochdale Literary and Scientific Society. Vol. xi., 1912–13. Pp. 134+xxii. (Rochdale.)

Vorlesungen über landwirtschaftliche Bakteriologie. By Dr. F. Lohnis. Pp. viii+398+plates. (Berlin: Gebrüder Borntraeger.) 16 marks.

Koninklijk Nederlandsch Meteorologisch Instituut. No. 104. Oceanographische en Meteorologische Waarnemingen in den Indischen Oceaan. December, January, February (1856–1910). Tabellen. Pp. 222. Kaarten. Plates 25. (Utrecht: Kemink aand Zoon.) 6.50 florins.

Regenwaarnemingen in Nederlandsch-Indië. Drie en Dertigste Jahrgang 1911. Deel ii. Uitkomsten. Pp. xi+214. (Batavia: Landsdrukkerij.)

Desert and Water Gardens of the Red Sea. By C. Crossland. Pp. xv+158+plates. (Cambridge University Press.) 10*s.* 6*d.* net.

The "Wellcome" Photographic Exposure Record and Diary, 1914. Pp. 280. (London: Burroughs, Wellcome and Co.)

Mildews, Rusts, and Smuts. By G. Massee, assisted by I. Massee. Pp. iii+229+iv plates. (London: Dulau and Co., Ltd.) 7*s.* 6*d.* net.

Popular Natural History. By H. Scherren. New edition. Pp. vii+376+13 plates. (London: Cassell and Co., Ltd.) 3*s.* 6*d.*

Camping in Crete, with Notes upon the Animal and Plant Life of the Island. By A. Trevor-Battye. Including a Description of Certain Caves and their Ancient Deposits. By D. M. A. Bate. Pp. xxi+308+plates and map. (London: Witherby and Co.) 10*s.* 6*d.* net.

Spencer's Philosophy of Science. The Herbert

Spencer Lecture. By Prof. C. Lloyd Morgan. Pp. 53. (Oxford: Clarendon Press.) 2s. net.

The Celebration of the Two Hundred and Fiftieth Anniversary of the Royal Society of London, July 15–19, 1912. Pp. 128. (London: The Royal Society; Oxford University Press.) 5s. net.

The British Bird Book. Edited by F. B. Kirkman. Section xii. Pp. 405 to 692+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10s. 6d. net.

How to Enter the Civil Service. By E. A. Carr. New edition. Pp. xii+260. (London: A. Moring, Ltd.) 2s. 6d. net.

The Progress of Scientific Chemisrry in Our Own Times. By Sir W. Tilden. Second edition. Pp. xii+366. (London: Longmans and Co.) 7s. 6d. net.

A Laboratory Manual in Physics. To accompany Black and Davis's Practical Physics for Secondary Schools. By N. H. Black. Pp. x+117. (London: Macmillan and Co., Ltd.) 1s. 8d. net.

Physics: an Elementary Text-Book for University Classes. By Dr. C. G. Knott. Third edition, revised and amplified. Pp. vi+370. (London and Edinburgh: W. and R. Chambers, Ltd.) 7s. 6d.

Die Natur als Künstlerin. By Ernst Haeckel. Together with Formenschatz der Schöpfung, by Dr. W. Breitenbach. Pp. 114. (Berlin: Vita Deutsches Verlagshaus.)

A Description of the Imperial Bacteriological Laboratory, Muktesar: its Work and Products. By Major J. D. E. Holmes. Pp. 47+plates. (Calcutta: Superintendent, Government Printing, India.) 8 annas, or 9d.

Index Kewensis Plantarum Phanerogamarum. Supplementum Quartum. Pp. 252. (Oxford: Clarendon Press.) 36s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 20.

ROYAL SOCIETY, at 4.30.—*Medullosa Pusilla*: Dr. D. H. Scott.—Neuromuscular Structures in the Heart: Prof. A. F. S. Kent.—The Alleged Excretion of Creatine in Carbohydrate Starvation: G. Graham and E. P. Poulton.—The Origin and Destiny of Cholesterol in the Animal Organism. XI. The Cholesterol Content of Growing Chickens under Different Diets: J. A. Gardner and P. E. Lander.—Contributions to the Biochemistry of Growth—The Lipoids of Transplantable Tumours of the Mouse and the Rat: W. E. Bullock and W. Cramer.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Treatment of Tin Ores in Cornwall: A Description of the Geevor Mill: H. G. Nichols.—The Occurrence of Gold in Ontario: J. B. Tyrrell.

LINNEAN SOCIETY, at 8.—The Travels of Sir Joseph Hooker in the Sikkim Himalaya: H. J. Elwes.

FRIDAY, NOVEMBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Cutting Power of Lathe Turning Tools: Prof. W. Ripper and G. W. Burley.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Electrical Maintenance: T. A. St. Johnston.

MONDAY, NOVEMBER 24.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations on the Eastern Karakoram: Mrs. Bullock Workman and Dr. Hunter Workman.

INSTITUTE OF ACTUARIES, at 5.—Approximate Valuation of Endowment Assurances: W. P. Elderton.

TUESDAY, NOVEMBER 25.

ZOOLOGICAL SOCIETY, at 8.30.—The External Characters and Biology of Bryde's Whale, a New Rorqual from the Coast of South Africa: Ørjan Olsen.—A New Species of Trematodes of the Genus Lechriorchis from the Dark Green Snake (*Zamenis gemonensis*): Miss M. V Lebour.—Cirripedes from the Cenomanian Chalk Marl of Cambridge: T. H. Withers.—The Peroneal Muscles in Birds: Dr P. Chalmers Mitchell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Construction of the "White Star" Dock and adjoining Quays at Southampton: F. E. Wentworth-Sheilds.

WEDNESDAY, NOVEMBER 26.

ROYAL SOCIETY OF ARTS, at 8.—Zoological Gardens: Dr. P. Chalmers Mitchell.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Tuareg: M. Fr. de Zeltner.

INSTITUTE OF CHEMISTRY (Imperial College of Science, South Kensington), at 8.—The Research Chemist in the Works, with Special Reference to the Textile Industry: W. P. Dreaper.

THURSDAY, NOVEMBER 27.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: A Method of Measuring the Pressure Produced in the Detonation of High Explosives or by the Impact of Bullets: Prof. B. Hopkinson.—Gravitational Instability and the Nebular Hypothesis: J. H. Jeans.—The Diffraction of Light by Particles comparable with the Wave-length: B. A. Keen and Prof. A. W. Porter.—Note on the Colour of Zircons, and its Radio-active Origin: Prof. R. J. Strutt.—The Influence of the Constituents of the Crystal on the Form of the Spectrum in the X-ray Spectrometer: Prof. W. H. Bragg.—The Analysis of Crystals by the X-ray Spectrometer: W. L. Bragg.—*And other Papers.*

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Characteristics of Insulation Resistance: S. Evershed.

CONCRETE INSTITUTE, at 7.30.—Steel and Reinforced Concrete Chimneys: H. Cane.

FRIDAY, NOVEMBER 28.

JUNIOR INSTITUTION OF ENGINEERS, at 8. Patent Protection: A. Abley.

PHYSICAL SOCIETY, at 5.—The Expansion of Silica: Prof. H. L. Callendar.—The Thermal Expansion of Mercury and Fused Silica: F. J. Harlow.—An Experimental Method for the Production of Vibrations on Strings: Prof. J. A. Fleming.—A Double-fibre String Galvanometer: W. Apthorpe.

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, NOVEMBER 27, 1913.

A LESSON FOR ENGLAND.

Japan's Inheritance. The Country, Its People, and Their Destiny. By E. Bruce Mitford. Pp. 384 + plates. (London: T. Fisher Unwin, n.d.) Price 10*s*. 6*d*. net.

THE author of this account of the country of Japan has not only travelled through it with the observing eye of a geographer, but he has consulted the best papers which have been published by geologists and experts in seismology. He gives what seems to be a true account of the position of Japan among the nations, and of her ambitions. Travellers will find the book a useful addition to the books which give the impressions of the globe-trotter, but the author cannot be said to have made more than a superficial study of the social phenomena exhibited by Japan in the last forty-five years.

The Mikado was a combination of a *roi-faineant* and a god; the Shogun was the ruler of a feudal state; religion was Confucianism or Buddhism, permeated by Shintoism, which in a few words may be said to be really patriotism and ancestor teachers of ancient classics. The structure was in many ways beautiful, but it proved to be without physical strength. Its extreme weakness proved its salvation. Even the teachers of classics saw that for a poor nation to be strong, scientific method must permeate the thought of the whole population. And now, at the end of the first chapter in Japan's modern history we find a nation which can not only defend itself, but which retains all of its religion that was beautiful. Every unit of the population can not only read and write, but it is fond of reading, and its education did not cease when it left school. It is getting an increased love for natural science, so that it can reason clearly; it is not carried away by charlatans; it retains its individuality. One result of this is that in time of war Japan has scientific armies. Not only are its admirals and generals scientific, but also every officer, every private is scientific. The accounts of many of our European wars must seem to a Japanese like a Gilbert and Sullivan opera. The country is naturally very poor, and its finance requires twenty times the wisdom which has been found sufficient for any European Chancellor of the Exchequer, but such wisdom is now obtainable in Japan. Everything in the whole country is being developed scientifically, and we Europeans, hag-ridden by pedantry in our schools and universities, refuse to learn an easy lesson.

Japan's present aim is quickly to make herself strong in war. She has other aims. The Japanese knows that his ancestors were highly civilised when our ancestors were savages in the Baltic forest, but Japan forgoes her higher aims until she is strong enough to be respected.

J. P.

MOLECULAR PHYSICS.

Die Existenz der Molkule. Experimentelle Studien. By Prof. The Svedberg. Pp. viii + 243 + iv plates. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1912.) Price 12 marks.

THE molecule, originally conceived as the basis of chemistry, and apparently firmly established as the foundation of the kinetic theory, was at the end of last century no longer the centre of progress. When, therefore, W. Ostwald suggested that it no longer played an essential part in chemical theory, he found many German chemists ready to deny its existence. About this time Prof. Svedberg began the experimental researches which are described in this book. It is therefore not surprising that he takes the proof of the reality of molecules as the central idea, to which all his experimental work is referred.

The volume serves chiefly as a record of the author's own work, but includes brief references to the results obtained by others in the same field, and also an enumeration of the various methods by which molecules have been made manifest in the last few years. It has been divided into two sections. The first section deals with phenomena which concern molecules in the aggregate. Here experiment must usually be interpreted in terms of the kinetic theory. The author's work on the diffusion of colloids gives in this way a remarkably good estimate of the weight of a molecule, while from the diffusion of some true solutions a guess may be made at the shape of the molecules concerned. The absorption of light by colloids provides complicated, but very interesting results of which the most important from the author's point of view is the fact that the behaviour of the smallest colloid particles approximates to that of a true molecular solution.

In the second section the molecules are dealt with singly. The word molecule has here been liberally interpreted, for the Brownian movements of colloid particles have been included under this heading. Prof. Svedberg was the first to prove experimentally that these movements agree with the calculations made by Einstein and Smoluchowski from the kinetic theory, and half the book is devoted to this subject. By marshalling his own results, and those of others, he shows what a fine proof is thus provided of the truth of the kinetic theory. When a colloid suspension in water is observed with an ultramicroscope, the number of particles in the field of view is constantly fluctuating, because the particles are moving haphazard. By observing the extent of the fluctuations, the author has been able to test how far the behaviour of the colloid is in agreement with the simple gas laws. He has also invented a most ingenious method of measuring the concentration fluctuations in a molecular solution. A solution of a polonium salt in water is used, and the rate at which α particles are shot off provides a measure of the concentration of the solution. Unfortunately radio-active change is just as haphazard as the movements of molecules, so that the fluctuations in the emission of α particles are due to the two causes combined. Experimental difficulties have been overcome, and the two effects separated, the result being in agreement with the kinetic theory.

This book is not merely a collection of reprints, for the original papers have been re-written into a connected whole, while some of the material had not previously been published. Unfortunately, however, the author has made no attempt at condensation, and the very interesting subject-matter is at times lost in a plethora of numerical results. Considerable tracts, such as pp. 152–164 and 183–195, resemble a laboratory note-book, and even the lucid descriptions of experimental arrangements leave too little to the reader's intelligence. In a smaller book the importance and ingenuity of the experimental work would have held the reader's interest. H. G. J. M.

FLIGHT PRINCIPLES AND PRACTICE.

(1) *The Flight of Birds.* By F. W. Headley. Pp. x + 163 + xvi plates in text. (London: Witherby and Co., 1912.) Price 5*s.* net.

(2) *The Mechanics of the Aëroplane.* A Study of the Principles of Flight. By Capt. Duchêne. Translated from the French by J. H. Ledeboer and T. O'B. Hubbard. Pp. x + 231. (London: Longmans, Green and Co., 1912.) Price 7*s.* 6*d.* net.

(1) MR. HEADLEY is well known, in the Aëronautical Society and outside it, for his interesting studies of bird flight. If he has not much that is novel to say about the more controversial points on which some difference of opinion still remains, he is yet able to write very pleasantly and instructively, and often from his own observation, about all the main features of bird flight; and the series of the author's photographs selected for reproduction makes one wish for more.

The point of view throughout is that of the interested and intelligent observer, describing and so far as possible explaining his observations. The explanations are given in the simplest possible manner, and are as clear as need be. The opening chapter on gliding flight might perhaps be improved in the light of the most recent knowledge, but the criticism is of no importance; the book is written for the lover of nature, not the technical expert. The questions dealt with include stability and steering, starting and alighting, soaring, pace and endurance, varieties of wing and of flight, flight machinery and some accessory characteristics. It is a volume which will be read with pleasure by those interested in flight, and in birds.

(2) The purpose of this book, in the words of the translators' preface, is "to explain in terms as simple as possible, and with a minimum of formulæ, the main principles of dynamic flight; to give the ordinary reader an insight into the various problems involved in the motion and equilibrium of the aëroplane; and to enable him to calculate in the simplest possible manner the various elements and conditions of flight." Judged from this point of view, the book is one which can be cordially commended to the "ordinary reader," for whom it is written. The elementary principles of aërodynamics applicable to the aëroplane as expressed by the usual formulæ derived from experimental observation, are given in their simplest, approximate, form; and the logical deductions which can be made from these formulæ are explained with care and conciseness. All the main points of importance can be brought out in this manner, and the result will enable the reader who is prepared to take the small amount of trouble required to follow the argument to obtain an intelligent grasp of the conditions under which the flight of an aëroplane can be sustained.

The reader new to the subject will probably be surprised to find how simple and how few in number are the fundamental formulæ and ideas required. These comprise the formulæ expressing the "lift" and "drift" in terms of the velocity and angle of incidence; a little information as to the movement of the centre of pressure; and some general ideas as to the effect of camber, and of aspect ratio. With this apparently slender equipment, and some acquaintance with the laws of elementary mechanics, a tolerably complete discussion is given of the main principles of flight, including even a chapter on the screw-propeller.

The apparent simplicity thus obtained is, indeed, from another point of view, one of the main defects of the book. The simple law assumed for the variation of lift with angle of incidence might well have been illustrated by the reproduction of a curve showing this variation for some common type of aëroplane wing, giving instructive information as to the limits within which the simple law may be taken to hold. Other similar experimental results available at the time the volume was written might well have been made use of.

Part II. of the work is devoted to consideration of the equilibrium and stability of the aëroplane in still air. These two questions of equilibrium and stability are not kept as distinct as they should be, and we fear some confusion in the mind of the reader must necessarily result. The ideas put forward on the subject of stability are of interest, but the experimental basis is, of course, too slender for any satisfactory examination into this question, which cannot be dealt with in so elementary a manner.

The merits of the original work of Captain Duchêne are well preserved by the translators, both of whom, from their intimate association, both practical and literary, with aëronautics, have special qualifications for their task. The lucidity and terseness of the French are reproduced in the English version, and the choice of equivalents for technical terms is particularly happy.

OUR BOOKSHELF.

The Archaeology of the Anglo-Saxon Settlements. By E. Thurlow Leeds. Pp. 144. (Oxford: Clarendon Press, 1913.) Price 5*s.* net.

This book is suggestive, in the sense that while it raises many interesting problems, the material at present available does not admit their complete solution. Dealing with a period of about 200 years, from the first coming of the Saxon invaders down to the cessation of the evidence furnished by the pagan interments, Mr. Leeds attempts, from a survey of the archæological remains, to supplement and correct the literary record. These historical sources are admittedly much later than the events of the early invasions which they profess to record—Prosper Tiro, Gildas, Procopius, and Zozimus belonging to the fifth and sixth centuries, followed by Bede and the Anglo-Saxon Chronicle.

Mr. Leeds' method is to study the remains discovered in interments both in Great Britain and on the Continent, and to discuss their bearing on the historical record. The chief difficulty lies in the comparative scarcity of remains in the period which he is investigating, and, in the case of objects of art, like jewelry and metal-work, of discriminating between objects which may have passed from one tribe to another in the course of trade, and those which can with certainty be attributed to certain races or areas. The book bears the marks of rigid compression. A more extended narrative, a larger amount of illustration, better maps, and occasional summaries of conclusions, would make it easier reading. It may be hoped that he will be encouraged to treat the subject in more detail, and that the publication of the book will lead to more active search for remains of the Anglo-Saxon pagan age.

Even with these reservations, the book is a useful contribution to archæology. In some cases, as regards the early history of the West Saxons and the occupation of the Isle of Wight, the evidence of archæology is in direct conflict with current history. Among many intersting conclusions we may note that the distribution of the early settlements is based on the English river-system, and that the invaders avoided Roman roads and cities, partly with deliberate strategical intent, partly from a desire to place water between them and the ghosts supposed to haunt places destroyed by fire and sword. The female interments, as might have been expected, provide more interesting remains, in the form of jewelry and other ornaments, than those of males.

On the whole, the book is a valuable contribution to the early history of these islands, and its conclusions will deserve the serious consideration of future writers on this obscure period.

The Romance of Scientific Discovery. By C. R. Gibson. Pp. 318+plates. (London: Seeley, Service, and Co., Ltd., 1914.) Price 5*s.*

The title of this book covers an extremely large field, and anyone who attempts to deal with the manifold discoveries in so many branches of science undertakes a difficult task. In spite, however, of the many pitfalls, the author of this work has been fortunate in avoiding them. Mr. Gibson is a well-known writer of popular and non-technical works, and the present volume brings out his faculty of stating facts clearly and making the subjects he deals with interesting. To write about the romance of scientific discovery successfully must necessarily indicate that the author is well versed in the literature of many sciences, and that this is the case is shown by a perusal of the present volume. He has nevertheless taken the opportunity of consulting his many scientific friends who have read in manuscript the particular portions which deal with their special subjects.

The subjects dealt with are most varied, and are treated in twenty-three chapters, each restricted to some specific point. To mention a few, there are essays on discoveries concerning our planet, how the crust of the earth was formed, living creatures of past ages, microbes, discoveries in botany, chemistry, electricity, &c., and discoveries concerning the universe. Care has been taken not to burden the reader with a host of names and dates, and an appendix is given in which further details are mentioned and can be referred to if needed. A capital index is given, and the book is well illustrated with numerous excellent plates. The frontispiece illustrates the large refracting telescope at Treptow, near Berlin, and is described as the largest telescope in the world. The actual largest refractor in the world is that at the Yerkes Observatory, in the United States.

The Bacteriology of Diphtheria. Including Sections on the History, Epidemiology, and Pathology of the Disease, the Mortality caused by it, the Toxins and Antitoxins, and the Serum Disease. By Drs. F. Loeffler, A. Newsholme, F. B. Mallory, G. S. Graham-Smith, G. Dean, W. H. Park, and C. F. Bolduan. Edited by Prof. G. H. F. Nuttall and Dr. G. S. Graham-Smith. Re-issue with Supplementary Bibliography. Pp. xx+718. (Cambridge University Press, 1913.) Price 15s. net.

THE first edition of this exhaustive work was reviewed in the issue of NATURE for April 29, 1909 (vol. lxxx., p. 243). The editors point out in the present edition that the conclusions arrived at in the papers which have been published since the first appearance of the volume have mainly confirmed the opinions advocated in it; and consequently they decided only to add a supplementary bibliography of eight pages, recording the most important work published since 1908. In many instances the contents and conclusions of the papers included in the bibliography are indicated sufficiently in their titles; in other cases a brief summary of their contents has been added.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Migration Routes.

THE experience gained from flights on aëroplanes and from the behaviour of airships may throw some light on why migratory birds follow certain routes. Pilots in aëroplanes can easily see rivers and ponds, and these form better guides than roads and railways; main roads, now usually tar-coated, are not conspicuous, while the lighter coloured by-roads are more easily seen. There is evidence that migration routes are often along coast lines and river valleys; these are most conspicuous features in an uninhabited country, and birds when flying in the daytime below the clouds could have no difficulty in following them by sight.

When flying at night, or above the clouds, birds would be able to follow the coast-line by the sound of the waves breaking on the shore. Dr. Gadow believes, both from theoretical considerations and from his observations, that birds have very acute power of hearing faint sounds. Thrushes apparently are able to detect earthworms by the noise they make just before they come out of their holes in the earth. Owls have remarkably well-developed ears, both external and internal, and the silence of their flight perhaps has been partly developed to enable them to detect slight sounds. Birds no doubt appreciate the songs of their mates, and parrots have the power of reproducing sounds with great exactness. Dr. Gadow adds, that judging from the structure of the ear, most anatomists think that the power of hearing in birds is much inferior to that of mammals. He does not, however, agree with this opinion.

Observations on sound from an aëroplane are impossible because of the noise of the engine and propeller. But from a balloon sounds can be heard easily. People shouting have been heard at 4500 ft.; a gun at 8200 ft.; a dog barking at two miles; a band playing at 11,800 ft.; a railway train at 4900 ft.[1] Other observers have noticed the barking of dogs, the crowing of cocks, and the bleating of sheep when high up.

Mr. Griffith Brewer heard on one occasion the sound of the sea breaking on the shore. He was over the English coast with an offshore wind and a calm sea underneath him, and the sound he heard came from the breaking of the waves on the French coast at least twenty-five miles away. He was amongst the clouds in falling snow, and could see nothing. As the wind carried him along over the sea the sound of the waves gradually increased, and this was the only assurance of his continued approach to the French coast.

Even in calm weather the sound of the waves would be easily heard by birds when at a considerable height. Those who have lived a short distance inland are familiar with the sound from the shore on calm nights. When there is much wind the waves breaking are not heard because of the sounds produced by the wind in the trees or buildings near. The intensity of the sound from a single source, such as a dog barking, will vary inversely as the square of the distance, but if the sound comes from a line instead of a point its intensity will only vary inversely as the distance. Mr. Mervyn O'Gorman has pointed out that this is one of the reasons which accounts for the great distance to which the sound from the sea breaking on the shore will carry.

Osborne Reynolds has discussed the refraction of sound caused by wind and also by the variation of the temperature of the air at different heights above the ground.[2] The refraction caused by wind reduces the carrying power of the sound to a place on the earth's surface to windward. Usually the temperature of the air falls with increasing height, and this reduces the carrying power of the sound in all directions to places on the earth's surface. When the direction of the sound makes a large angle to the surface of the earth the intensity of the sound will not be reduced. On one occasion during his experiments the calls from the occupants of a boat were heard on a yacht more than five miles distant. In this case the direction was horizontal, and no doubt the conditions were exceptionally favourable for the transmission of sound, but we should expect the conditions generally to be good for the transmission of sound in an upward direction, where there are no solid objects to make sound shadows.

It seems then that birds can have little difficulty in following coast-lines by day or night.

Migrating birds, however, can only follow rivers by sound when these are so wide as to have waves breaking on their shores or so rapid that sufficient noise is made by the water tumbling over rocks.

Mr. Griffith Brewer tells me that at night ponds and rivers are indistinguishable from grass fields even in bright moonlight, except that the surface of the water acts as a mirror in which the brilliant reflection of the moon or even of a star is seen. This can only be an efficient guide to migrating birds on moonlight nights with a clear sky and when they are flying in such a direction that the image of the moon in the water is within their field of vision. Most birds have their eyes at the sides of their heads,[3] and this would give them the power of watching the reflection of the moon in a river or sea when it is

[1] Report on Eight Balloon Ascents in 1862 by James Glaisher, F.R.S. B.A. Report, 1862, p. 490.

[2] See "Papers on Mechanical and Physical Subjects," by Osborne-Reynolds, F.R.S., pp. 89 and 157.

[3] Certain carnivorous birds have their eyes more in front; birds follow the same general rule as other animals; the eyes of the hunter are in front which must help him to see his prey, and the eyes of the hunted are at the side of the head to enable him to watch his pursuer.

almost behind them, whereas man could only see the reflection when flying more or less towards it.

In following these routes birds may also be able to travel with less exertion. When the sun is shining, land is warmer than water; the reverse is the case at night. This difference of temperature causes a downward air current over water on sunny days, and in calm weather this is most markedly felt even when passing over as small a piece of water as the Fleet Pond near Farnborough. This pond is about 1000 yards long and about 700 yards wide at its widest point, and is very shallow. Mr. O'Gorman tells me that on a sunny day a balloon drifted slowly over the pond and at once began to fall with considerable rapidity through a distance of perhaps 2000 feet, and ballast had to be thrown out to prevent it reaching the water. Aëroplanes are sensitive to the down current over quite small ponds on sunny days, and drop in passing over them. We thus have direct evidence of a downward current over a small sheet of water on a sunny day, and this must mean an updraught over the land near the water.

Coast-lines are often marked out by cumulus clouds during the daytime. Dr. Shaw tells me that this is an indication of local rising air currents, and that the bases of clouds of this type are assigned to a height of from 4000 to 5000 ft.

If birds make use of these upcurrents they should fly over the land near the water in the daytime, and if there is a wind they should fly on the windward side of a river. Observations on this point would be of great interest. In windy weather the upcurrent would be much reduced, and perhaps would be inappreciable.

At night we should expect the opposite effect to be produced, but I know of no evidence on this point, and the upcurrent over water may be inappreciable. To take advantage of it, if it exists, birds should fly over water at night, or if there is a wind on the lee side of a river.

An on-shore wind striking against the cliffs produces an upcurrent, and this also birds would find advantageous.

There may be other advantages in valley routes, such as perhaps better conditions with regard to wind, and Dr. Gadow has pointed out to me that many of the birds that follow coast-lines and rivers are aquatic or semi-aquatic, and that even the more terrestrial birds will find better stores of food in river valleys than along the bordering hill ranges.

The foregoing throws very little light on the difficult problems involved in the migration of birds. It is hoped, however, that other and more important observations will be made from aëroplanes and airships, and that these will enable us to understand a little more about the mystery of the migration of birds.

HORACE DARWIN.

November, 1913.

The Elephant Trench at Dewlish.

IN the hope of finding an explanation as to the origin of the so-called elephant trench at Dewlish, Mr. Clement Reid (NATURE, vol. xcii., p. 96), asks if under desert conditions, there is any tendency for winds to cut trenches with rounded blind ends in soft limestone deposits. Having travelled in the Egyptian and other deserts, and having camped for some months on soft Tertiary limestones in the stormy region at the mouth of the Gulf of Suez, a few remarks from my pen may be of interest in this connection.

The only desert locality where I have seen trenches at all resembling that at Dewlish is in the Jemsa area near the mouth of the Gulf of Suez. On the low flat isthmus which joins the headland of Ras Jemsa to the mainland there are cracks or openings in the soft "Raised Beach" deposits which cover the Tertiary Gypseous limestone formation of this area. The cracks are usually directed N.E.–S.W., and are parallel to the slip-planes which have disturbed the underlying deposits. The prevailing wind, which is strong and persistent, blows from the N.W. off the plain behind the Gebel Zeit range. Part of the sand and dust which it carries is dropped when its velocity decreases, namely in any hollow or wind-shadow that may occur. The cracks above-mentioned, which may be likened to crevasses in glaciers, form one of the receptacles for this wind-borne material, and being thus partially filled and obliterated, are not easily observed, and men and camels have been known to flounder into them. The fact that they are only partially filled shows that they are in process of formation now, and their origin would seem to be due to the solution of both series of deposits along such lines of weakness as joints or slip-planes.

The infilling of hollows is typical of the desert and we know that an artificially excavated hole is not deepened, but, on the contrary, tends to be obliterated by wind-driven sand.

If a rock of uniform texture but containing hard nodules, such as flints, is abraded by sand, the surface is fluted, and small hollows are scoured round the nodule. Mr. Reid's letter does not suggest the presence of such hollows, and their absence must be regarded as another point against the wind-erosion theory.

From the description of the trench, I gather that it occurs, not on the edge of a plateau, but on the surface of the open downs, and thus resembles, as Mr. Reid suggests, the well-known *swallow-holes* of the Great Scar Limestone, which frequently engulf sheep and other denizens of the plateaux. Mr. Reid writes in the singular number, as if only one end of the trench was rounded. This again is a feature common to swallow-holes, where the detritus carried by the disappearing stream abrades only the upstream end of the hole. Is this rounded end so situated with regard to the surrounding chalk topography that it would be possible for a stream of water to have entered the trench from that end? Mr. Reid tells us that open trenches in the chalk are unknown elsewhere; are not the deep and narrow holes in the chalk, now filled with red clay, which are to be seen in the railway cuttings between Cambridge and London, supposed to have the same origin as the *sinks* of the Yorkshire wolds?

As cracks and joints in the chalk are conspicuous by their absence, perhaps the point or line of weakness, which originally determined the position of the trench, has been eroded away completely. The question arises—Is there any relation between the direction of the trench and the direction of the joints in the country rock?

The nature of the bottom of the trench and the relation of the trench to the surrounding topography should tell us something definite as to its possible origin, but in the meantime I think we may regard the wind-erosion hypothesis as untenable.

H. T. FERRAR.

Survey Department of Egypt, November 5.

On a Habitat of a Marine Amœba.

As our knowledge of marine Amœbæ is very scanty it is worth while recording what appears to be a common habitat of one of these animals.

At various times from May to October this year Amœbæ were observed casually in the water obtained by squeezing out the contents of the gastral cavity of Sycons. Occasionally they were obtained in this way in fair quantity. It was therefore thought probable that a more careful examination of a number of these sponges would be interesting in determining whether this habitat is a usual one. Accordingly twenty specimens of *Sycon coronatum*, varying in length from about 2 to 4 cm., were examined. The contents of the gastral cavities of these specimens were squeezed on to a slide and a careful search for Amœbæ made.

Of the twenty specimens thus examined one or more Amœbæ were found in all except three. Usually about three or four specimens were obtained from each sponge; only one Amœba, however, was found in a few of the squeezings, but from one sponge nineteen of these animals were counted, and doubtless not all those present were seen. It is therefore evident that these sponges are a common habitat of marine Amœbæ, whence these lowly animals may be obtained fairly easily.

There is no likelihood that this habitat is an exclusive one; doubtless Amœbæ occur in a great many other situations in the sea, from which, however, they can only be obtained with some difficulty.

The Amœbæ obtained from the sponges were rather small. Specimens when measured in one common phase were found to be about 80 μ long and 40 μ broad, being, however, in this phase almost uniform in breadth, and having only slightly rounded ends, but when creeping such specimens stretch out to a length of more than 90 μ. The animals move quickly, progressing often in a straight line and flowing with a motion somewhat like that of planarians; at other times thick, blunt, and—at first—hyaline pseudopodia may be extruded from one or more parts of the body. So far as has been observed, the animals appear to have a definite posterior end. The protoplasm is highly and coarsely granular, except at the periphery, and in some specimens ingested diatoms and other inclusions were to be seen. The contractile vacuole has not been made out definitely, but a stainable vesicle of constant size visible through a high power of a microscope in the anterior region of the living animal appears undoubtedly to be the nucleus. The absence of an easily visible nucleus and nucleolus makes it easy to distinguish the Amœbæ from the more or less amœboid forms of some sponge cells, which, moreover, are mostly spherical, and do not show anything like the active movement of the Amœbæ.

In their general characters these Amœbæ resemble the species described by Gruber (*Zeits. für Wiss. Zool.*, vol. xli., 1885, Leipzig, "Studien über Amöben," p. 219) as *Amoeba crystalligera*, but further investigations are necessary to establish their identity with that species.

J. H. ORTON.

The Laboratory, Plymouth.

A Remarkable Meteor on November 24.

LAST night, November 24, at 8.47 p.m., a very remarkable meteor was seen in the northern sky. It moved slowly in an east to west direction, describing a straight path of about 10° in length, which made a small angle (of some 20°) with the horizon, the eastern end being the lower, and remained visible for four or five seconds.

It presented a comet-like appearance, having a bright nucleus surrounded by a less intensely luminous envelope, which streamed out behind, forming a kind of double tail. Conspicuous blue (or green) flares were visible in the "tail," but the appearance lasted such a short time that I am unable to state exactly how they were distributed. It vanished as suddenly and as silently as it had flashed out.

The northern sky being overcast at the time, it was, of course, impossible to lay down its track relatively to the stars, but its position was referred to some tree-tops, which were silhouetted against the sky, and from observations made next morning I am able to state that the middle point of the apparent track was situated at an altitude of about 17° above the horizon, and at about 7° or 8° east of the north point.

Although seen through clouds which were sufficient to obscure all stars in its neighbourhood, including the conspicuous constellation of Ursa Major, the meteor appeared far more luminous than the planet Venus even at its brightest. In fact, with one exception, it was the brightest meteor I have ever seen. The one exception was the splendid daylight meteor of February 8, 1894, which appeared in full sunshine within a few minutes of noon, but was still bright enough to attract the attention of thousands of people at various places over an extended tract of country, from London to Whitby, and from Chelmsford, in Essex, to Ballinasloe, in the west of Ireland.

ARTHUR A. RAMBAUT.

Radcliffe Observatory, Oxford, November 25.

Darwinism 100 Years Ago.

IN reference to Dr. Gadow's interesting quotation from Tiedemann (NATURE, November 13), may I remind your readers that the principle of sexual selection was clearly enunciated by Erasmus Darwin in his "Zoonomia," first published in 1794? I quote from an edition of 1800. "A great want of one part of the animal world has consisted in the desire of the exclusive possession of the females; and these have acquired weapons to combat each other for this purpose. . . . So the horns of the stag are sharp to offend his adversary, but are branched for the purpose of parrying or receiving the thrusts of horns similar to his own, and have therefore been formed for the purpose of combating other stags for the exclusive possession of the females; who are observed, like the ladies in the times of chivalry, to attend the car of the victor. . . . The final cause of this contest amongst the males seems to be that the strongest and most active animal should propagate the species, which should thence become improved."

ARTHUR DENDY.

University of London, King's College, November 19.

Intra-atomic Charge.

IN a previous letter to NATURE (July 20, 1911, p. 78) the hypothesis was proposed that the atomic weight being equal to about twice the intra-atomic charge, "to each possible intra-atomic charge corresponds a possible element," or that (*Phys. Zeitschr.*, xiv., 1912, p. 39), "if all elements be arranged in order of increasing atomic weights, the number of each element in that series must be equal to its intra-atomic charge."

Charges being known only very roughly (probably correct to 20 per cent.), and the number of the last element Ur in the series not being equal even approximately to half its atomic weight, either the number of elements in Mendeléeff's system is not correct (that was supposed to be the case in the first letter), or the intra-atomic charge for the elements at the end of the series is much smaller than that deduced from experiment (about 100 for Au).

Now, according to Rutherford, the ratio of the scattering of α particles per atom divided by the square of the charge must be constant. Geiger and Marsden (*Phil. Mag.*, xxv., pp. 617 and 618, notes

1 and 2), putting the nuclear charge proportional to the atomic weight, found values, however, showing, not constancy, but systematic deviation from (mean values) 3·825 for Cu to 3·25 for Au. If now in these values the number M of the place each element occupies in Mendeléeff's series is taken instead of A, the atomic weight, we get a real constant (18·7±0·3); hence the hypothesis proposed holds good for Mendeléeff's series, but the nuclear charge is not equal to half the atomic weight. Should thus the mass of the atom consist for by far the greatest part of α particles, then the nucleus too must contain electrons to compensate this extra charge.

Table of the Ratio of the Scattering per Atom Divided by A^2 Compared with that Divided by M^2.

	I.	II.	Mean	Mean × 5·4	Mean × A^2/M^2	M
Cu	3·7	3·95	3·825	20·6	18·5	29
Ag	3·6	3·4	3·5	18·9	18·4	47
Sn	3·3	3·4	3·35	18·1	19·0	50
Pt	3·2	3·4	3·3	17·8	18·6	82
Au	3·4	3·1	3·25	17·5	18·4	83
Mean	3·44	3·45	3·445	18·6	18·6	

A. VAN DER BROEK.

Gorssel, Holland, November 10.

The Stone Implements of the Tasmanians.

IN reply to Mr. J. P. Johnson's letter on Tasmanian stone implements in NATURE of November 13, attention may be directed to the paper read by M. Exsteens before the International Prehistoric Congress at Geneva last year, and destined to appear in vol. ii. of the *Compte-rendu*. It seems that the common opinion in Europe as to the culture represented by these relics of a recently extinct race was based principally on rejects from a large collection; and an inspection of the better worked specimens is sufficient to upset their eolithic origin in favour of a later stage, viz. Le Moustier-Aurignac, which is precisely Mr. Johnson's view. In 1906 the Rev. C. Wilkinson and Mr. Anthony presented a small but typical series of that character to the British Museum.

REGINALD A. SMITH.

Society of Antiquaries of London,
Burlington House, W., November 18.

Museum Glass.

IN connection with a work I am writing on "The History of Anatomy," I have been induced to trace the rise of the anatomical museum, and this appears to have depended to a larger extent than one would have suspected on the price of spirit and museum jars. In the second half of the eighteenth century John Hunter was using about 5000 museum jars for his spirit preparations. It would be interesting to learn whether these were made specially to his order, as I suspect, which firm he dealt with, and how much he was charged. Perhaps some old-established glass manufacturers can give me some isolated or continuous records of the prices of circular and rectangular glass jars used in museum work, and also the period when they were first manufactured in the ordinary course of business routine. From 1750 to 1850 is the period of most importance.

F. J. COLE.

University College, Reading, November 15.

CAPTAIN SCOTT'S LAST EXPEDITION.[1]

CAPTAIN SCOTT'S last journal has the deep interest of one of the most tragic documents in the history of exploration, for the fate of his party on its return from its magnificent and successful journey will surround his name with the romance that immortalises those of Franklin and of Burke and Wills. The human interest of Captain Scott's journals is greater than the geographical, for his route by the Beardmore Glacier was the same as that of Shackleton to one hundred miles from the Pole, and the remainder of the route was over a plateau with no special features of interest apart from its position. The reader therefore naturally hurries through the accounts of the voyage out, the landing on the middle of the western coast of Ross Island, the depôt laying in the first season, the happy life at the winter quarters, and the reports of enthusiastic scientific investigation by the staff. He will read with pleasure the eulogies of Dr. Wilson and the tributes to the capacity and enterprise of all the members of the expedition; and he may note, too, that Captain Scott started greatly preferring ponies to dogs, and that the old *Discovery* hut was used as an intermediate station on the way to the Barrier; the remarks that it was cold is not surprising, since half its heating apparatus had been left in New Zealand, and the insulating material on which its warmth depended was not inserted.

The Southern Party, with its various supporting parties, started between October 24 and November 3, with sledges drawn by motors, ponies, and dogs; and this part of the narrative inevitably recalls the old maxim against mixed transport. The transport was, however, gradually unified by the failure of the motors and the shooting of the ponies, the flesh of which was used as food, mainly for the dogs. After the fateful return of the dogs from the lower end of the Beardmore Glacier on December 12, the journey was continued with man-hauled sledges, with the aid of two supporting parties, which returned later. Eighteen miles from the Pole came the discovery of a camp and many dog tracks, followed by finding Amundsen's tent and letters, which have given conclusive evidence that both parties reached their goal.

The interest increases in the story of the return march, maintained with heroic persistence in spite of the ever-growing difficulties and weakness, which led to the final tragedy only eleven miles from the ample store of food and fuel at One Ton Depôt. There is no direct statement as to the real cause of the disaster. Dr. Wilson's diary may be expected to contain more explicit evidence; but though various extracts from Dr. Wilson's diary are quoted on comparatively unimportant details, there is none regarding the main problem. The

[1] "Scott's Last Expedition." In 2 vols. Vol. i., Being the Journals of Captain R. F. Scott, R.N., C.V.O. Pp. xxvi+633+plates. Vol. ii., Being the Reports of the Journeys and the Scientific Work undertaken by Dr. E. A. Wilson and the Surviving Members of the Expedition. Pp. xv+534+plates. Arranged by Leonard Huxley. With a Preface by Sir Clements R. Markham, K.C.B., F.R.S. (London: Smith, Elder and Co., 1913.) Price 42s. net.

gradual collapse of Evans with his shed finger nails, burst blisters, suppurating wounds, and mental lethargy, the swelling of the feet which gradually affected the whole party, and the few other symptoms stated, and those which may be read between the lines, all indicate scurvy as the cause of the gradual weakening of the party; and as the provisions had been cut down to a minimum, the slow progress rendered necessary the reduction of the daily rations. The fall which is said possibly to have injured Evans is apparently hypothetical, and would have happened so late in his illness that it would be an effect, and not a cause. The explanation that the party was finally stopped by a ten days' blizzard is inadequate, for though meteorological observations are not given for all the days between the arrival at the final camp and Capt. Scott's last entry, the weather to the north during part of the time is described as cold but fine; and though blizzards may be local, it seems most improbable that one should have lasted sufficiently long to have prevented the last march of eleven miles to One Ton Depôt, unless the men had been incapacitated by weakness.

Dr. Wilson's journals may contain more precise information, but from the general evidence in Captain Scott's, it appears probable that scurvy was responsible for the disaster. The last pages in the journal are ennobled by the magnificent courage with which the men awaited their slow but inexorable doom.

The second volume consists of the narratives of the subsidiary expeditions and preliminary statements of the scientific work accomplished, and thus calls here for longer notice. It would have been convenient if the names of the authors had been given in the list of contents. The volume opens with an account of the arduous journey by Dr. Wilson, Lieut. Bowers, and Mr. Cherry-Garrard in the mid-winter of 1911 to the Emperor Penguin rookery on the edge of the Barrier. This bird nests in the coldest season of the year, and as knowledge of its embryology might give very interesting results, an expedition was made to collect the young eggs. According to the opinion quoted in vol. ii., p. 77, Captain Scott considered this journey to have been the hardest which has ever been done. The temperature recorded of -77° F. has only been exceeded in Siberia.

Photo.] FIG. 1.—Amundsen's tent at the South Pole. From "Scott's Last Expedition." [*Lieut. Bowers.*

The narrative of the Northern Party is given by Commander Campbell, who, with Dr. Levick, Mr. Priestley as geologist, and three men, were sent in the *Terra Nova* to reach King Edward Land, east of the Barrier. The steamer was unable to penetrate the pack ice, and according to the alternative instructions from Captain Scott, the party was landed at Cape Adare at the winter quarters of the Southern Cross Expedition. It therefore became the Northern instead of the Eastern Party. Cape Adare proved an unsatisfactory base, as the effort to explore the coast to the west proved impossible owing to the unfavourable condition of the ice. The party was confined to a more detailed survey of Robertson Bay. In the following spring the six men were transferred to Terra Nova Bay for a summer's work in that district. The *Terra Nova* was unable to relieve them in the autumn, owing to the thickness of the pack ice and, as they had been landed with only stores and equipment for the summer, they had to live through the winter on the resources of the country. Seals and penguins provided their food and fuel; they dug a dwelling house in a snowdrift, and after a winter of great privations they sledged down the coast to McMurdo Sound; they found a food cairn just in time, and were shortly afterwards rescued by the *Terra Nova*. It appears from Commander Campbell's narrative that they began the winter with very slight hope of living through it, and their survival reflects the highest credit on their courage, resource, and good comradeship.

The remaining narratives are the record of the ascent of Mt. Erebus by Mr. Priestley, of the last year's life at Cape Evans and the search for the Southern Party by Dr. Atkinson, and of the various voyages of the *Terra Nova* by Commanders Evans and Pennell.

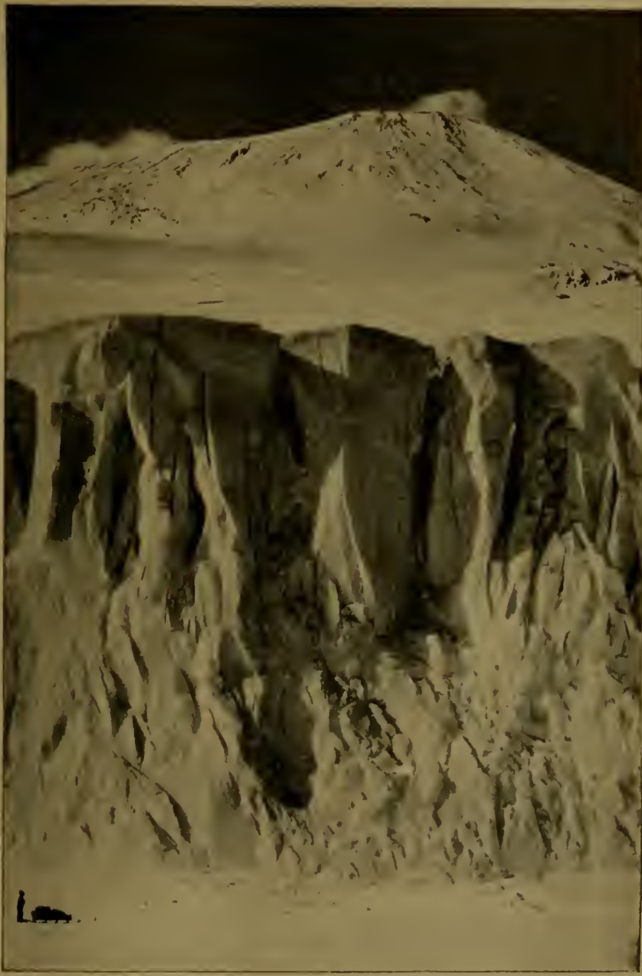

Photo.] FIG. 2.—The ramparts of Mount Erebus. From "Scott's Last Expedition." [*Mr. H. G. Ponting.*

The last section of the volume consists of general sketches of the scientific work undertaken during the expedition, but most of these are mainly statements of the work undertaken, for it is of course too early to know the results. They will obviously prove very important. Two of the most complete sections are those on the geological work on the mainland west of McMurdo Sound by Mr. Griffith Taylor and Mr. Debenham. Mr. Taylor reproduces an interesting diagram by Prof. David showing the striking resemblance in structure between the coast of South Victoria Land and the Pacific coast of Australia. The geological collections and observations have not yet been worked out, but sufficient is announced to show that very important results were secured. According to the first accounts, this coast includes granites of two ages. Prof. David and Mr. Priestley, during the Shackleton Expedition, referred all the granites to one period; according to the present volume (p. 433), the granites are of infinite variety, and probably belong to many ages. The majority are assigned to the interval between Cambrian times and the deposition of the Beacon Sandstone; and perhaps the most important contribution that is promised by this expedition is the determination of the age of these sandstones owing to the discovery of some fossil plants, which are said to be much better than the indefinite remains collected by the two previous expeditions. The specific identification of the fossils is expected, and they are said to indicate a late Palæozoic age. Further details are given of the great dolerite sill intruded into the Beacon Sandstone, and from the description it appears to be strikingly like that which forms the most conspicuous feature on the central highlands of Tasmania. Some copper ore was found on the cliffs at Cape Bernacchi.

Mr. C. S. Wright describes the nature of his observations on the properties of ice, and briefly discusses the cause of the northward flow of the Barrier. It is now universally agreed that the Barrier is due to the accumulation of snow, as first suggested in NATURE, and as the ice is afloat close to its landward end, it can only flow northward; and if the snowfall is continuous across it the velocity is necessarily greatest along its northern edge. Mr. Wright has also described the magnetic, electrical, and pendulum observations, and the measurements of the radioactivity of the air.

The biologist, Mr. Lillie, has given a short summary of the zoological work, and as fifteen rich trawl hauls were made, many new species may be expected. He remarks, however, while though there is an extraordinary wealth of individuals, the variety of forms is not very great, whereas the one Antarctic haul of the *Challenger* contained the highest proportion of new forms. But Mr. Lillie's result is what would have been expected, especially in the shallower waters.

The meteorological report by Dr. Simpson, though he says it will take years to work out the full results, contains some interesting suggestions. One passage illustrates the malicious irony of fate. He points out "one can now say definitely that the blizzards which have been so fateful to British Antarctic exploration are local winds confined to the western half of the Ross Barrier" (vol. ii., p. 463). He adds: "If this had been known previously, the history of the conquest of the South Pole would have been very different." Dr. Simpson was originally selected as the physicist for the expedition of the *Discovery*, but he was rejected on the grounds of health by the naval medical authorities. If he had gone on that expedition its observations on its chief meteorological problem would not have been set aside as unintelligible, and his conclusion would no doubt have then been so clearly recognised that the great Antarctic tragedy might never have occurred.

Both volumes are superbly illustrated by photographs by Mr. Ponting, including one in natural colours, and by coloured plates after the beautiful sketches by Dr. Wilson.

J. W. G.

RADIUM RESOURCES.

AN address to the sixteenth annual convention of the American Mining Congress, Philadelphia, October 20–24, by Mr. C. L. Parsons, of the Division of Mineral Technology, Bureau of Mines, is published in *Science* of October 31, dealing with the present commercial situation as regards radium and its ores, the available sources of radium in America and elsewhere, the prospecting for, concentration, and costs of mining carnotite, and the probable future of radium in the treatment of disease. A bulletin is about to be issued by the Bureau of Mines, and an advance statement was issued in April directing attention to the fact that in 1912 nearly three times as much radium in the form of carnotite deposits was produced from Colorado as from all the rest of the world put together, and was exported almost entirely to Europe.

The publication of this statement has already resulted in a considerable increase in the selling price of the material, and has rendered ores containing less than 2 per cent. of uranium oxide saleable, whereas before they were worthless. American carnotite is found in several districts in Colorado (Montrose and San Miguel counties), the Paradox Valley being described as the richest known radium-bearing region of the world, and in Utah, north-west of these counties, the deposits of which are of lower grade, but cost less in transportation than those of Colorado. In the latter case (Paradox Valley) mining costs 28 dollars to 40 dollars, and hauling charges to the railway 18 dollars to 20 dollars. The costs in the European markets average 70 dollars, and a 2 per cent. ore at Hamburg now sells at 95 dollars per ton. Mechanical concentration has been successfully employed, and it appears can save at least one-half of the material now wasted.

The equilibrium amount of radium (element) in a 2 per cent. U_3O_8 ore is about 5·25 milligrams per ton. The actual amount present in carnotite may safely be reckoned to be at least 4 mg., which, when extracted, sells for about 100*l*. Of this sum 20*l*. represents cost of raw material, leaving 80*l*. per ton margin for the cost of extraction and profits of the manufacturer and salesman.

Efforts are being made to foster the production of radium in the U.S.A., for although the total value of the world's output is insignificant, compared with that of commoner materials, being estimated for 1912 as 1,000,000 dollars, its potentialities in work for the public knowledge and public weal cannot be measured in cash. A National Radium Institute has been formed, working in conjunction with the Bureau of Mines, for the performance of experiments and publication of results in concentration of carnotite ores, reduction of present wastage, and the extraction of sufficient radium for extensive trial in the treatment of cancer.

From a point of view nearer home, it is clear that, as in the case of the Austrian deposits, so also everywhere where radium is found, the question of its supply will be regarded more and more as of national importance, and a nation trusting to the equitable operation of the laws of supply and demand is likely to be squeezed out. The situation for this country is a sufficiently serious one. Nothing is more certain than that, if radium is to be of use in the treatment of cancer, small quantities are not merely worthless, but may even do harm rather than good. Grams of radium in each large centre of population, kept in operation every minute of the twenty-four hours, alone will meet the impending development. Whence is it to be obtained? Austria and America have the radium, Germany the mesothorium raw material. A future source of supply for this country is a question of national concern, though we have not, like the Bureau of Mines in America, a ministerial department likely to move in the matter spontaneously. In the public interest the matter should be lifted once for all above the plane of private venture and financial speculation. Will not the Institution of Mining and Metallurgy fulfil this public duty in lieu of a Bureau of Mines, and appoint an expert committee, mainly of practical mining authorities, but with representatives of technical chemistry and medicine, to consider the situation and take energetic steps to meet it?

Frederick Soddy.

PRESENTATION OF THE BUST OF SIR HENRY ROSCOE TO THE CHEMICAL SOCIETY.

THE former students of the Right Hon. Sir Henry Roscoe decided some time back to commemorate the celebration of his eightieth birthday in January, 1913, by presenting his bust to the Chemical Society of London. With this object in view a committee was formed, of which Sir Edward Thorpe has acted as chairman, and on which many prominent chemists who were students of Sir Henry's during the long period he occupied the Chair of Chemistry at Owens College, now the University, Manchester, were associated. The formal presentation of the bust, a photograph of which is here reproduced, was made at the Rooms of the Chemical Society on Thursday last, November 20.

Among those present, in addition to Sir Henry Roscoe, were Miss Roscoe, Mr. and Mrs. Mallet, Mrs. Edward Enfield, Mr. E. W. Enfield, Sir Edward Thorpe, Sir Archibald Geikie (president of the Royal Society), Prof. W. H. Perkin (president of the Chemical Society), Prof. H. E. Armstrong, Prof. H. B. Dixon, Prof. P. F. Frankland, Dr. Hugo Müller, Prof. W. Odling, Prof. Emerson Reynolds, Sir William Tilden, Sir Thomas and Lady Barlow, Sir J. Rose Bradford and Lady Bradford, Sir Henry Miers, Dr. Aubrey Strahan (president of the Geological Society) and Mrs. Strahan, Mr. Harry Baker, Mr. E. J. Bevan, Dr. Horace T. Brown, Dr. J. C. Cain, Dr. H. G. Colman, Prof. A. W. Crossley, Dr. J. Kent Crow, Dr. Dobbie, Mr. J. M. Fletcher, Prof. Harden, Mr. A. J. King, Dr. C. J. Martin, Dr. Rudolph Messel, Dr. E. J. Mills, Mr. Pattison Muir, Dr. J. C. Philip, Mr. Rupert Potter, Prof. Schuster, Dr. Alexander Scott, Mr. Evelyn Shaw, Dr. S. Smiles, Mr. Watson Smith, Dr. A. Smith Woodward, and Dr. Charles A. Keane (secretary to the committee).

Sir Edward Thorpe first presented to Sir Henry Roscoe the following address from his former students, which had been given him in a preliminary form on the actual day of his birthday, and to which the signatures of those associated with the commemoration had now been added.

On April 22, 1904, the jubilee of your doctorate of Heidelberg University, it was the privilege of 300 of your friends and pupils to express to you their

Bust of the Right Hon. Sir Henry Roscoe.

appreciation of your services to chemical science, and especially their gratitude to you for your stimulating influence as their teacher, and for your personal interest in their progress and welfare which has endeared you so lastingly to one and all.

To-day, on the attainment of your eightieth birthday, we gladly welcome a further opportunity of recording our continued appreciation of your long life and work. We extend to you our most sincere and heartfelt congratulations, and rejoice to know that you have been granted health and strength thus to prolong your successful labours and activities, and to add to the large debt of thanks that is your due from your pupils, your science, and your country.

Although it is now twenty-seven years since you resigned the chair of chemistry at Owens College, your influence as our teacher and friend has continued with us. Amongst your former pupils there are many who, thanks to the teaching they received at your hands, have been enabled to contribute to the advancement of science, and who in their turn, both in academic work and in industry have been privileged to train a second generation of men—your chemical grandchildren—whose labours it is hoped may add further testimony to the inestimable value of your guidance and example.

As a permanent tribute of our gratitude and affection towards you and in grateful remembrance of all your kindnesses and encouragement to us, we desire, on this occasion, to present your bust to the Chemical Society of London. We trust this proposal will commend itself to you, and that it will be some pleasure to you and your children to know that such an association with the representative Chemical Society of this country will be established for all time.

We sincerely wish that you may be spared to enjoy further years of good health, happiness, and activity.

The address had been signed by about 140 of Sir Henry's former students, many of whom now occupy responsible positions both in academic work and in association with chemical industries, and are to-day distributed not only in all parts of the United Kingdom, but also in Germany, Russia, Canada, the United States of America, Australia, South Africa, and Japan.

Sir Edward Thorpe then unveiled the bust of Sir Henry Roscoe, and on behalf of the subscribers asked the president of the Chemical Society to accept it as a permanent memento from Sir Henry's former students of his lifelong association with, and interest in, the welfare of the society. Sir Edward also extended to Mr. Albert Drury, R.A., the thanks of the committee for the excellent and striking likeness that he had secured. He also asked Sir Henry to accept as a further memento from his students a replica of the bust for himself and the members of his family, which was in course of preparation.

The gift to the Chemical Society was acknowledged by the president, Prof. W. H. Perkin, F.R.S., who said he felt sure that it would be a great pleasure to the members of the council and to the fellows of the society to place the bust in a fitting position in their rooms, where they would always value it as a token of the great admiration and affection they all had for Sir Henry Roscoe. He also expressed to Sir Henry Roscoe the appreciation of the fellows of the society for his continued interest in the society, and for the valuable donations that he had given them, especially in connection with their library.

Sir Henry Roscoe, in acknowledging the gifts both to himself personally and to the Chemical Society, expressed the great pleasure that it gave him to be present, and to say how deeply touched he was by this renewed expression of esteem and affection thus shown to him by his old pupils.

"No honours, no rewards, can, I think," he said, "compare with this, and to these men, whom I like to look upon as my scientific sons, come my heartfelt thanks. To their kindness rather than to my own deserts is this fresh recognition due, for looking back over my fourscore years of life, I see how small the deeds, great though the will may have been. To you, Sir Edward Thorpe, as chairman of the committee, as well as to Dr. Charles Keane, the secretary, and to the other members of the committee, my special thanks are due. I thank the Chemical Society through you, Mr. President, for the great honour it has done me by placing my effigy in its library. I cannot flatter myself that the coming generation of fellows of the Chemical Society will look upon my face with the veneration with which they will gaze on the features of the great masters whose busts adorn your walls, but if the sight of this one recalls to their memory that this was a man who loved his science, his teaching, and his students, and if that sight helps to imbue them with a like love, then perhaps my bust in your library may be of some use. Now, my friends, I thank you all, and wish you all God-speed."

NOTES.

We regret greatly to announce that Sir Robert S. Ball, F.R.S., Lowndean professor of astronomy and geometry in the University of Cambridge, and director of the Cambridge Observatory, died on Tuesday, November 25, at seventy-three years of age.

The Home Secretary has appointed a Committee to inquire what action has been taken under the Wild Birds Protection Acts for the protection of wild birds, and to consider whether any amendments of the law or improvements in its administration are required. The members of the Committee are:—The Hon. E. S. Montagu, M.P., Under-Secretary of State for India (chairman); Lord Lucas, Parliamentary Secretary to the Board of Agriculture; Mr. Frank Elliott, of the Home Office; Mr. E. G. B. Meade-Waldo, Mr. W. R. Ogilvie Grant, and Mr. Hugh S. Gladstone. The secretary to the Committee is Mr. H. R. Scott, of the Home Office, to whom any communications on the subject of the inquiry may be made.

The death is announced, at fifty-one years of age, of Mr. H. F. B. Lynch, well known by his extensive travels in the Middle East for purposes of scientific, political, and commercial research.

An exhibition of one hundred and forty of the remarkable series of photographs, greatly enlarged, taken by Mr. H. G. Ponting during the British Antarctic Expedition of 1910–13, will be opened on Wednesday next, December 3, at the Fine Art Society, 148 New Bond Street, London, W.

The death is announced, in his fortieth year, of Dr. Ora W. Knight, who had been consulting chemist and assayer to the State of Maine since 1903. He had previously been assistant chemist at the Maine experiment station for several years. Dr. Knight was known as an ornithologist and a botanist; he was the author of a standard book on the birds of Maine, and his herbarium contained a nearly complete collection of the plants of that State.

The death is announced of the veteran Italian geologist, Prof. Igino Cocchi, of Florence. He was born in 1828, and was one of the most active pioneers in stratigraphical geology in Italy. In 1867 he became the first president of the committee directing the Geological Survey of Italy, which he had been mainly instrumental in founding. Some of his studies were made in England, and he was elected a foreign correspondent of the Geological Society of London in 1874.

The Smithsonian Institution announces the following changes in the *personnel* of the department of geology, United States National Museum:—Dr. E. T. Wherry, late assistant professor of mineralogy at Lehigh University, has been appointed assistant curator of mineralogy and petrology in succession to Mr. Joseph E. Pogue, transferred to the United States Geological Survey; Dr. J. C. Martin has been appointed assistant curator of physical and chemical geology in succession to Mr. C. G. Gilbert, appointed curator of mineral technology.

A MEETING of the council of the Zoological Society of Scotland has just been held, at which a very satisfactory report was made on the working of the Zoological Park for the period during which it has been open. Since the end of July, when the park was opened to the public, 102,233 visitors have entered, while the receipts at the gate for the three and a half months have resulted in a surplus of about 1000*l.*, after paying the expenses of upkeep for five months. The number of specimens received during the period was 420; the health of the stock is excellent, and the death-rate has been very light. Twenty new fellows were admitted, and the number of fellows on the roll now exceeds 2000.

WE are glad to see that the scale of charges for the services of the official guide appointed a short time ago to conduct parties of visitors round the collections contained in the garden, plant-houses, and museums of the Royal Botanic Gardens, Kew, and to point out objects of particular botanical interest, has been greatly reduced. Hitherto the scale of charges has been 2*s.* 6*d.* for each person attending a morning tour, and 1*s.* for each person attending an afternoon tour, but in future these charges are to be 6*d.* and 3*d.* respectively. These charges are so low that no one need now be deterred from participating in the instructive tours around the gardens taken by the guide daily.

DR. H. BAYON, research bacteriologist to the Union Government of South Africa, gave a lecture at the Royal Society of Medicine on November 20, on the leprosy problem in the British Empire. He pointed out that the latest returns showed that in India the leper population had increased from 100,000 to 110,000. Dealing first with treatment, Dr. Bayon stated that in selected cases a vaccine prepared with certain cultures had given promising results. He finally urged that it is the duty of every Government to prevent the further spread of leprosy by the use of all the means of preventive medicine, and, in particular, by the institution of a system of universal segregation of all lepers.

IN connection with a suggested removal of the statue of Charles I. at Charing Cross, *The Field* of November 15 directs attention to the interest attaching to the "great horse" on which the King is mounted. These "great horses," one of which is represented in a picture by Vandyke in Buckingham Palace, executed from an animal in the Royal stables, "were the direct descendants of the Italian horses Altobello and Governatore . . . sent over to the stud at Hampton Court by the Marquis of Mantua as a present to King Henry VIII., and the breed was still further improved by the two splendid Spanish horses sent to King Edward VI. by Charles V. in 1552, which were of the type shown in the well-known sketches by Rubens."

PARTICULARS of the Pierre J. and Edouard Van Beneden prize of 2800 francs are given in the Bulletin of the Royal Academy of Belgium (Classe des Sciences, 1913, No. 7). The prize is to be awarded every three years to the Belgian or foreign author or authors of the best original work of embryology or cytology written or published during the three years preceding the date on which competing theses must be received. For the first competition this date is December 31, 1915. The manuscript works may be signed or anonymous, and the French, German, or English language may be employed. Authors should send their contributions, duly stamped, to the permanent secretary of the Academy, Palais des Académies, Brussels, inscribed "Concours pour le Prix Pierre-J. et Edouard Van Beneden."

THANKS largely to the kindness of the Percy Sladen Trust, an expedition left Perth, West Australia, a few days ago, for the Abrolhos Islands. The group is situated about forty miles out in the Indian Ocean from the coast of Western Australia, and roughly 300 miles north of Perth. The expedition has been organised by Prof. W. J. Dakin, of the new University of Western Australia, and accompanying him is Mr. W. B. Alexander, of the Perth Museum. From many points of view this little group of islands is of great interest. The wreck of the Dutch East India Co.'s ship, *The Batavia*, under the command of Capt. Pelsart, in 1629, is said to have led to the first recorded discovery of Australia. Whether true or no, the mutiny of part of the wrecked crew and the story of their final capture is worthy of any fiction. Plutonic rocks occur in one of the island groups, but the others are coral formations. It is said that not only does the terrestrial fauna bear interesting relations to the mainland, but that the intervening forty miles of sea separate two totally distinct marine faunas. Whilst the coastal fauna at this latitude is temperate, the island marine fauna is understood to be tropical. The members of the expedition intend making a close investigation of the fauna and flora of the islands and surrounding reefs. The material collected will be reported upon in the usual way by specialists.

DR. ANTON FRITSCH, director of the natural history departments of the Royal Bohemian Museum, and for many years professor of zoology in the Royal Bohemian University, died after a brief illness at Prague on November 15, aged eighty-one. Dr. Fritsch's first published work (1851) was a list of the Bohemian, German, and Latin names of the birds found in Bohemia; and throughout his life he took the deepest interest in the local fauna, making many contributions to knowledge, especially of the birds and fishes. In 1891 he founded a small station for the special study of the fresh-water fauna of the Bohemian lakes. Dr. Fritsch will be best remembered, however, by his numerous researches on the fossils of the Permian and Cretaceous formations of Bohemia, the results of which were published in several volumes. His "Fauna der Gaskohle" (1879–1901) will always remain a standard work of reference on the early Labyrinthodont Amphibia, and it forms a monument to his patient industry. Most of the fossils described were pyritised and unfit for study and preservation in the ordinary manner. Dr. Fritsch therefore cleaned away all the petrified material, leaving only the casts in the shale, from which he took clear impressions by an electrotype process. He was thus able to make good use of specimens which at first sight appeared of little value. His enthusiasm made him an inspiring teacher, and he has left several pupils who are diligently prosecuting the researches he suggested to them. Dr. Fritsch was a foreign member of the Geological Society of London, from which he received the Lyell medal in 1902.

NATURAL philosophy in general and palæontology in particular have lost an ardent disciple and a zealous worker by the death of Henry Potonié at Berlin on October 28. He was born November 16, 1857, in Berlin, where from 1878–81 he studied botany, becoming in 1880 assistant in the Botanic Garden, and scientific "Hilfsarbeiter" in the museum. His association with the garden is marked by a descriptive account of the plant-geographical arrangement of its contents by Prof. Engler, which Potonié published in 1890. A more important botanical work was the "Illustrated Flora of North and Central Germany," issued in 1885, and subsequently in several enlarged editions. In 1885 Potonié became associated with the Prussian Geological Survey, and from that time onwards palæobotany claimed the greater share of his activities. In 1887 he published a comparative anatomical study of recent Pteridophytes and of *Cycas revoluta*, with the view of the determination of the fossil species of the older formations. This was the first of a long series of important papers bearing on fossil botany published by the Geological Survey. In 1891 he became professor of palæobotany at the School of Mines (Bergakademie), and in 1897–9 appeared the well-known text-book, "Lehrbuch der Pflanzenpalæontologie," on a new edition of which he was working immediately before his last illness. His valuable work, "On the Origin of Coal and other Combustible Minerals," is based on a course of his lectures. In 1901 he was appointed "Landesgeologe," and also joined the teaching staff of the University. He was the founder of the *Naturwissenschaftliche Wochenschrift*, with which he was associated for twenty-four years, and of which he was editor at the time of his death; a recent number has a short appreciation and good portrait. During his last illness he received the honour of Geheim-Bergrat.

THE October issue of *The National Geographic Magazine* is largely devoted to an article, illustrated by a fine collection of photographs, of a journey by Mr. G. Kennan through the eastern portion of the province of Daghistan, in the south-eastern corner of European Russia, between the Black Sea and the Caspian. He describes the splendid mountain scenery, the result of the intrusion of igneous rocks on the sedimentary strata, the whole worn down and torn into precipitous ravines by subsequent denudation. The population is of the most varied character —Aryan, Arab, Tartar, Crusader, and refugees from the adjoining regions have left their mark. Many individuals, if dressed in the costume of western Europe, would certainly be taken for Englishmen, Scotchmen, Bavarians, or Saxons. The homes often assume the character of the pueblos or cliff-dwellings of New Mexico. The peoples speak some thirty languages, with numerous dialects. The prevailing religion is Islam. Many archaic customs and a primitive tribal organisation survive, but Russian domination and the extension of education tend to promote the growth of uniformity.

CAPTAIN H. G. LYONS brought the subject of relief in cartography before the research meeting of the Royal Geographical Society on November 20, indicating that British contributions to this important branch of cartography are not numerous. He discussed the relative value of contours, hachures and coloured shading, and their utility as measured by their applicability to different kinds of map. He summarised the limits of scale within which each method best serves its purpose, and showed reasons why, outside these limits, one method or another fails to fulfil its function properly. Such a summary should form a valuable guide to cartographers, although when the author stated that hachuring becomes "conventional" on a scale smaller than about 1 : 500,000, because this this scale so compresses ridge and valley in mountainous regions, he might have been taken to task by the artist of such a map as the Swiss sheets in "Stieler" (1 : 925,000), who might have suggested that convention is to be distinguished from careful generalisation. The author also brought out the limitations of contour systems in portraying gently undulating ground—a point which the student often has need to remember. He dealt at length with various systems of colouring used in conjunction with contours, and discussed the basis of "physiological optics," on which the selection of colours for this purpose ought to rest.

DR. AND MRS. WORKMAN gave the Royal Geographical Society, at its meeting on Monday, November 24, an account of their further explorations, conducted last year, among the Karakoram Himalayas. Their objective on this occasion was the Siachen or Rose Glacier. Mrs. Workman indicated the course of their journey, and gave an account of their additions to the map of the region, incidentally controverting the views of previous visitors on several points. The surveyor who accompanied the party was Mr. C. Grant Peterkin. To the pass at the head of the Bilaphond Glacier Mrs. Workman applies the name of the glacier itself, and not that of Saltoro. attached to it as "traditional" by Dr. Longstaff. She dealt with the same explorer's high peak of Teram Kangri, which he gave as 27,610 ft. high, while Mr. Peterkin made it only 24,560 ft. She observed for the first time a group of lofty peaks behind the east Siachen wall, on the Turkestan side, which form additions to the map, and others from the Silver Throne plateau, to the highest of which (24,350 ft.) the name of Queen Mary was given. The possibility of the Siachen glacier having provided an old route into Chinese Turkestan was considered and dismissed, in spite of the discovery of remains of rude buildings at high altitudes. Dr. Workman dealt in detail with the geology of the region and the character and work of the glaciers; his paper was perhaps of most notable interest in the paragraphs which described the junction of "probably the largest existing valley tributary outside the polar regions . . . with the largest known valley glacier." These are the Tarim Shehr (two miles wide) and the Siachen, which is 2¾ miles wide just above the junction. The two are compressed into the width of the main valley below the junction.

To the October number of the American Museum Journal Mr. R. C. Murphy communicates a graphic and richly illustrated account of his experiences among the petrels, penguins, and sea-elephants of South Georgia during a visit to that desolate island undertaken on behalf of the museum and the Brooklyn Institute, much interesting information being also given with regard to the eight whaling stations on the island. One of the most interesting photographs

A king-penguin incubating its egg.

(here reproduced) shows a king-penguin incubating its single egg, which is supported on the instep, where it is covered by a fold of the skin on the under surface of the body, the bird standing all the time in the upright posture, and the two sexes relieving one another in the duties of incubation. Although the whales are stated not to show at present serious signs of diminution in number, in spite of the rapid rate at which they are being killed off, the prospects of the sea-elephants appear deplorable. "Slow, unsuspicious, gregarious, they can be hunted profitably until the last one has gone to his ancestors, and the calamity of the Antarctic fur-seal is repeated." The fate of these gigantic seals depends, then, it would seem, on the results of the investigation now being conducted on behalf of the Colonial Office.

In *The American Naturalist* for October (vol. xlvi., p. 577) Dr. R. Pearl discusses the measurement of the intensity of inbreeding. He points out the principles which must govern such an attempt, and shows that it is possible to find a coefficient by which the amount of inbreeding can be represented, so that different cases can be compared. The coefficient is based on the ratio of the actual to the possible number of ancestors in any generation, and therefore indicates the amount of inbreeding for a given number of generations back. The latter part of the paper discusses the differences between close inbreeding in bisexual reproduction and self-fertilisation of hermaphrodites, and shows that in some important respects the two are not comparable. An abstract, with some new material, is published in Bull. 215, Maine Agricultural Experiment Station.

A critical study of the conditions connected with the preparation of plantation para rubber has been made by Mr. B. J. Eaton, and the results of the inquiry are presented in Bulletin No. 17 of the Department of Agriculture, Federated Malay States. The endeavour of the author has been to collect as much trustworthy information as possible on the quality of rubber prepared by different methods and under different conditions so that such knowledge can be applied in indicating the causes underlying defects of rubber samples coming on the market. The effect of various coagulants and of dilution of the latex, period of coagulation, inhibitive substances, metal salts, light, and of micro-organisms on the quality of the rubber is dealt with at length. The use of sodium bisulphite as a means of inhibiting the action of oxidases and to ensure the production of light-coloured rubber has been found to be effective and profitable.

In the current *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, A. Granger gives an interesting outline of the rise and fall of the manufacture of *porcelaine tendre*, usually called "fritted" or "soft" porcelain. It seems to have been first made in Rouen, about 1673. The body of soft porcelain in its best days appears to have been made from an artificial glass (frit) mixed with a marl from Argenteuil; and after the body was fired it was covered with a plumbiferous glaze. This ware lent itself to particularly pleasing decorative effects, and the Sèvres factory made this variety of porcelain famous. The "narrow margin of safety" in manufacture led to a particularly large percentage loss. Possibly owing to changes in the character of the raw materials, &c., the losses finally became so great that the manufacture had to be abandoned, and soft porcelain was ousted by the regular type of "continental porcelain"—the so called *porcelaine dure*, or "hard" porcelain. The body of this type of ware is made from a mixture of felspar, clay, and quartz, and glazed with a felspathic glaze. Unlike soft porcelain, the glaze and body of hard porcelain are fired in one operation. Mr. Granger gives some old recipes and describes some interesting recent attempts to revive the manufacture of soft porcelain at Sèvres.

We have received several further letters from Mr. S. L. Walkden complaining about the statement in our review of his "Aëroplanes in Gusts," which was corrected by him in his letter to Nature of October 30. In reference to this matter the reviewer writes:—"I should have thought that Mr. Walkden's letter, together with my lengthy quotation from his book, would have been more than sufficient to remove any injustice that might have arisen through a statement of claim being made in the reviewer's and not the author's words. At the same time, it is necessary to warn readers that the amended claim contained in Mr. Walkden's letter must be read in conjunction with the lengthy quotation in NATURE, or better with the contents of the book itself, otherwise a false idea may be formed of the author's treatment. The only accelerations which the air can be said to *impress* on an aëroplane in the recognised Newtonian meaning of the term, are those due to the pressures of the air on its supporting surfaces, and are measured by the accelerations which the aëroplane would undergo if no other forces acted on it, their direction being in the direction of the corresponding impressed forces. In these circumstances a gust having a downward *velocity* would impress a downward, not an upward, acceleration on the aëroplane. It will be seen that the quotations from his book in my letter contain no reference to accelerations *impressed* by air pressures on the plane in this sense, and, *while I am quite willing to accept the author's amended statement of his claims,* I should not feel justified in stating these claims in this form without his written authority."

SIX years ago Prof. O. Knoblauch, of the Technical High School at Munich, determined the specific heat of superheated steam, at constant pressures, for temperatures up to 662° F., and pressures up to 124 lb. per sq. in. These experiments were conducted on a scale which directly appeals to the engineer, and the results, which Prof. Knoblauch obtained in conjunction with Dr. Max Jakob, are accepted largely by engineers. *Engineering* for November 7 contains an account, with drawings of the apparatus employed, of further experiments by the same investigators. Knoblauch has extended the range to 1020° F., up to pressures of 114 lb. per sq. in., and the experiments are being continued at higher pressures up to twenty atmospheres. Jakob has attempted to check the results by calculating the specific volume of steam, for the same high range of pressures and temperatures, from the experiments of Knoblauch and his collaborators, and also from the deductions of H. N. Davis, and by comparing these volume results with those directly determined. The research shows that the specific volume can be calculated from the specific heat, and the experimental values for the specific heat are thus confirmed. The general result is that the specific heat of steam at constant pressure increases with pressure, especially near the saturation line, though much less so, and scarcely at all finally, as the degree of superheating is raised. As the temperature rises, the specific heat, c_p, decreases to a minimum, to increase again slightly.

THE Cambridge University Press has recently made further additions to the "Cambridge Manuals of Science and Literature." The series now numbers eighty volumes, and its general excellence, to which attention has been directed on former occasions, is well maintained by the half-dozen books which have just been received. Three of the new volumes deal with biological subjects. Prof. G. H. Carpenter tells "The Life-Story of Insects," and provides an outline sketch of the facts and meaning of insect transformations. Prof. W. J. Dakin, in his little book on "Pearls," give a summary of the most important facts about pearls, pearl fishing, and pearl formation. The third biological topic is handled by Mr. H. Russell, who writes on "The Flea," and his book, which is, he thinks, the first in English devoted wholly to the subject, will prove particularly useful now that it is known that fleas are the active agents in spreading plague. Dr. E. J. Russell contributes a book on "The Fertility of the Soil," which is addressed to all who are keenly interested in the soil they are cultivating and want to know something more about it. Prof. A. H. Gibson, under the title, "Natural Sources of Energy," discusses the problem of forecasting the conditions of life and activity in future centuries. The sixth book, on "The Peoples of India," is by Mr. J. D. Anderson, who gives a popular account of the race and caste, the languages, and the religions of the various peoples in our Indian Empire.

MR. REGINALD CORY has received permission of the King to dedicate to his Majesty the volume, entitled "The Horticultural Record," which is to be published next month by Messrs. J. and A. Churchill. The work will contain numerous plates, coloured and half-tone, reproduced from photographs taken at the Royal International Horticultural Exhibition, 1912. Several well-known writers contribute articles on the progress of horticulture since the first international exhibition in 1866.

MESSRS. LONGMANS, GREEN AND CO. have in preparation "Chemistry of the Radio-Elements, Part ii., The Radio-Elements and the Periodic Law," by Mr. Frederick Soddy, F.R.S. This is an extension of the original monograph, and covers recent generalisations connecting the radio-active disintegration series with Mendeléeff's table.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR DECEMBER:—

Dec. 1. 22h. 1m. Uranus in conjunction with the Moon (Uranus 3° 9′ N.).
2. 3h. 0m. Mercury stationary.
,, 8h. 5m. Mercury in conjunction with Venus (Mercury 1° 34′ N.).
6. 21h. 0m. Saturn at opposition to the Sun.
10. 12h. 0m. Mercury at greatest elongation W. of the Sun.
12. 15h. 58m. Saturn in conjunction with the Moon (Saturn 6° 45′ S.).
15. 9h. 57m. Mars in conjunction with the Moon (Mars 0° 59′ S.).
,, 18h. 36m. Neptune in conjunction with the Moon (Neptune 4° 29′ S.).
20. 9h. 44m. Variable star, Algol, at minimum.
21. 22h. 35m. Sun enters sign of Capricornus. Solstice.
23. 6h. 33m. Variable star, Algol, at minimum.
25. 20h. 23m. Mercury in conjunction with the Moon (Mercury 5° 26′ N.).

26. 5h. 57m. Venus in conjunction with the Moon (Venus 5° 13′ N.).
28. 12h. 32m. Jupiter in conjunction with the Moon (Jupiter 3° 46′ N.).
29. 9h. 45m. Uranus in conjunction with the Moon (Uranus 2° 53′ N.).

A NEW HILL ASTRONOMICAL OBSERVATORY.—M. H. Perrotin, writing in the *Revue Générale des Sciences* (November 15, No. 21), records the foundation of a new hill observatory on Mont Salève, at an elevation of 1250 metres. This new observatory owes its origin to the fact that M. Schaer, of the Geneva Observatory, having completed the construction of a Cassegrain telescope of 100 cm. in diameter, looked for a suitable spot in the canton of Geneva where an observatory could be built in order to make the best use of this telescope. The plain of Geneva, bounded by the Jura, the Salève, and the lake, was always found to be invaded by the mist during the fine season and by fog in winter. Such bad observing conditions are nearly always associated with low-lying stations, and hence the general tendency of either moving old or creating new observatories on elevated sites removed from large rivers, lakes, and towns. M. Schaer's work has always been encouraged by M. Honegger, and it is due to the latter that this high site can be utilised. The observatory will be used both for astronomy and meteorology, and the chief astrophysical work will be the study of the spectra of the stars of the second and third magnitude with very great dispersion. An astrophysical laboratory will be attached, and an electric current of 500 volts will be available; spectroheliographic work will also be done. M. Schaer invites French astronomers or meteorologists to make use of the site either by using the observatory's instruments or any instruments they may like to bring with them.

MEASUREMENT OF RADIAL VELOCITIES BY OBJECTIVE GRATING SPECTROGRAPH. The determination of the velocities in the line of sight of the fainter stars is becoming an urgent necessity in astrophysics, and consequently efforts are being made to replace the slit spectrograph by other arrangements capable of utilising a greater proportion of the light available. To this end M. Maurice Hamy explains in a note in No. 17, *Comptes rendus*, a method by which an objective grating spectrograph may be employed for this purpose. The grating, preferably one giving under normal incidence only two symmetrical spectra, must be mounted so that these spectra may be photographed in two separate cameras. A collimator fixed to the same base is used to furnish comparison spectra from a terrestrial light-source. To eliminate the effects of variations of the angle of incidence the exposures on the star and comparison have to be intermittent and alternate. The reduction is based on a rigorous relation between directions of incident and diffracted beams, wave-length, constant of the grating, and order used. Two methods are given for the measurement of the plates.

SUN-SPOT AREAS FOR 1912.—Dr. Dyson communicates the usual annual summary relating to the areas and positions of sun-spots for the past year to the Monthly Notices of the Royal Astronomical Society (vol. lxxiii., No. 9), and its chief interest lies in the fact that that year and the present one includes the epoch of a minimum. In 1912 the mean daily spotted area was only thirty-seven millionths of the sun's visible hemisphere, while the values for 1910 and 1911 were respectively 264 and 64 millionths. Comparison is made between the years of minimum of the three preceding cycles; the values for 1878 gave an area of twenty-two, for 1889 an area of seventy-eight, and for 1901 an area of twenty-nine, so that the low value in the last-mentioned year is not quite attained in 1912.

Attention is directed to the fact that, up to September 12 of the current year, a "much feebler condition of sun-spot activity even than 1912" has been experienced, so that the sun-spot minimum now in progress is probably going to turn out an unusually low and prolonged one. Minima of this character have generally been followed by a slow rise to a low maximum. The fact that some small spots have been observed in high latitudes suggests the commencement of a new period of activity. It is interesting to note that since 1905, and including that year, the number of days on which photographs of the sun were taken have been either 364 or 365.

CURRICULA OF SECONDARY SCHOOLS.[1]

THE recently issued memorandum on the curricula of secondary schools displays with remarkable clearness the attitude of the Board towards educational problems. It is to be hoped that it will be widely read outside as well as inside the scholastic profession. Inevitably the influence of the Board on the work of the schools gets greater year by year, and it is vital to national progress that this influence should be exercised in a broad and enlightened spirit. We may state at once that we have never read an official document which gave us more reason to hope that the dangers of bureaucratic control will be avoided, while the opportunities for removing inefficiency and for coordinating and economising our educational resources will be watchfully grasped.

In the introduction we read:—"The present memorandum . . . is not intended to contain any dogmatic exposition of educational doctrine . . . the problems of education have to be re-stated for each generation . . . the Board could do no greater disservice than by attempting to check the spirit of exploration, experiment, and inquiry which should exist in every school. . . . Organisation alone cannot make a good school. The real success of the work depends on the harmonious activity of a well-equipped staff, and also—a fact not always sufficiently taken into account—on the cooperation of the parents."

Turning from these expressions of opinion, which, however excellent, are platitudes unless translated into practice, we find that the Board regards as cardinal and essential subjects "English language and literature, at least one language other than English, geography, history, mathematics, science, and drawing." Provision must be made for training in singing and manual work, and for promoting the physical development of the pupils. The memorandum lays emphasis on the fact that it is impossible for boys and girls to profit adequately if the duration of school-life be curtailed. The suggestion is put forward that some of the work hitherto restricted to technical schools may wisely be attempted in connection with the general education of the older boys and girls in the secondary school. The report truly states that, at present, time is often wasted in the middle and higher forms through the inefficiency of earlier teaching, through the absence of coordination (*e.g.* in the syllabuses for mathematics and science or for science and geography), and through the inclusion in the syllabuses of much that is trivial and unessential, to the neglect of what is of capital importance.

The question of insistence on Latin is left in a curious position. If only one foreign language be offered, the school is free to propose any language which is suited to the needs of the pupils and for

[1] Board of Education Circular 826. Price 2*d*.

which the instruction is efficient. If two languages are taken (other than English), one of the two must be Latin unless "the Board are satisfied that the omission of Latin is for the educational advantage of the school." This regulation has done injury to the study of German, and the British Science Guild and several teachers' organisations have objected. The Board now state that Latin will not be demanded if instruction therein is available in other accessible schools. The Board fear that the prospects of the pupils will be prejudiced if Latin is omitted, as they may be debarred from entry into professions and from university work in literary subjects. To the present writer it appears prejudicial to national progress that the education of thousands of boys and girls should be made less efficient because certain chartered corporations hold antiquated views regarding school curricula (on which subject they are seldom qualified to advise), or because those corporations may regard the exclusion of the un-Latined as a convenient social precaution.

The memorandum contains many useful suggestions with reference to the work of the more advanced pupils, and, so far as science is concerned, the recommendations will be approved by most of those who have had practical experience. Modified specialisation is the keynote—thus pupils specialising in science and mathematics should take English literature and composition and one foreign language, "which for those who have already spent some years in the study of French should by preference be German." Specialisation in art, economics, and domestic courses are also contemplated by the Board as permissible in selected schools, but with provision for the continuance of general education. As regards the main portion of the school, the study of science (including practical work) should extend continuously over four years. "This will be required in all schools unless special reasons to the contrary can be given." Boys who are working in preparation for an advanced course in classics may have a science course for three years (instead of four) between the ages of twelve and sixteen, if this course be supplemented by the inclusion of science among the subsidiary subjects taken at the specialising stage. This and similar statements in the memorandum should strengthen the resistance of enlightened headmasters to the injuriously narrow specialisation which still appears requisite for winning a scholarship at the older universities. G. F. DANIELL.

THE SPREAD OF THE METRIC SYSTEM.

IN a circular letter, dealing with the world-wide spread of the metric system, the Decimal Association points out that the time is soon coming when metric usage, instead of being regarded as a hindrance to British trade with the Far East, will have to be adopted as a necessity in our dealings with China, Japan, and Siam, which have each taken definite steps to establish that system. Already the Advisory Council of China has passed the first reading of a law to that effect, and two Chinese gentlemen are now in Paris studying the technical details of the subject. Japan has for the present four legal systems of weight and measure, but the Government has declared its preference for the metric system by making it obligatory for the services of the customs excepting a few articles. The metric system is taught in all the public schools of Japan, and is prescribed for the army, for medicine, and for electrical work. Siam has employed the system with success on its railways and public works for some years, and last year joined the International Convention of the Metre, from which it has received the apparatus needed for a Central Bureau of Standards at Bangkok. Siam proposes not to make metric reform compulsory at one and the same time in all parts of the kingdom, but to deal with each province separately at convenient times. Russia also has adopted the metric system for several purposes, and has announced to the Decimal Association that the metric system is favoured, but has to await the necessary arrangement of control and inspection throughout the Russian Empire. This conversion of Russia is notable as completing the solidarity of all Continental Europe in metric reform. All South and Central America are either metric or tending to be so. The Australasian Dominions of Great Britain have urgently pressed the question; and last, but most important of all, are the United States of America, which have gone far in preparing for reform, and will act with vigour when the time comes.

ZOOLOGY AT THE BRITISH ASSOCIATION.

SECTION D presented a full programme, the large number of communications rendering necessary morning and afternoon sessions. Interest in the proceedings was well maintained, good audiences being present throughout the meetings. A striking feature of this year's programme was the large number of papers dealing with vertebrate anatomy and morphology.

Some Aspects of the Sleeping Sickness Problem.

A lecture on this subject was delivered by Prof. E. A. Minchin. He referred briefly to the chief signs and symptoms of sleeping sickness, and described the main features of trypanosomes, remarking that the tendency of natural evolution appeared to be for the pathogenic species to adapt themselves to certain species of hosts, to which they become quite harmless. *Trypanosoma brucei, gambiense,* and *rhodesiense,* however deadly to domestic cattle and man, are harmless to the wild game, which appear to be their natural hosts. There is evidence that *T. rhodesiense* is a newly arisen strain of *T. brucei,* which has recently acquired the power of living in human blood, and, as a "new" parasite of man, is extremely virulent. Prof. Minchin pointed out the principal characters of tsetse-flies (Glossina), and the part played by certain species in transmitting the trypanosomes of sleeping sickness. In about 5 per cent. of the flies fed on infected blood, the trypanosomes ingested go through a complicated developmental cycle, multiplying in the fly's digestive tract, and, after a time, migrating forwards and passing into the salivary glands, where they establish themselves, multiplying constantly so long as the fly lives. It has been proposed to exterminate the wild game on a large scale in order to remove this "reservoir" of the disease, but Prof. Minchin considered it to be doubtful whether this would bring about the desired effect. Destruction of the game would remove only a portion of the reservoir, for ruminants generally, including domestic stock, can harbour the trypanosomes in question, and, further, such destruction, by removing the natural food of the flies, might cause the flies to move closer to human habitations, and hence increase the transmission of the disease among human beings and domestic stock. He hoped, therefore, that if game is to be destroyed, this will be done in limited areas only, until more accurate knowledge of the results has been acquired. He suggested that reduction of tsetse-flies might be effected, (1) by protecting the wild gallinaceous birds, by introducing species not indigenous, and by encouraging the natives to keep domestic fowls round their villages, for such birds, when scratching up the ground, would find and destroy the pupæ of Glossina; and (2) in areas where *G. morsitans* is common, by tarring or stopping up in some way all holes in trees near the villages.

Bionomics of Amphidinium operculatum.

Mr. R. Douglas Laurie described observations, made chiefly on the Cheshire coast, on this Peridinian, which occurs in such numbers as to form brownish-green patches on the sand, just below high-water mark of spring tides. The organism exhibits three periodicities. (1) A daily periodicity; during the latter half of February the patches were very evident on the surface of the sand until 10 a.m., then the organisms retired below the surface, reappearing shortly after noon, and reaching a maximum from 2 to 4 p.m., after which they again disappeared. Experiments indicate that light and tide are the determining factors, temperature being apparently unimportant. (2) A lunar periodicity, "spring" periods of activity, alternating with "neap" periods of inactivity, being correlated with the amount of water in the sand, for the neap tides do not reach the region inhabited by Amphidinium. (3) An annual periodicity, a strongly marked maximum from February to the end of April being followed by decrease during May and June. The patches have not been seen on the sand since the first week of July, though microscopic examination showed that a few Amphidinium were still present. Mr. Laurie described a large and more elongate form of Amphidinium, which he is inclined to regard as a distinct species.

Influence of Osmotic pressure on the Regeneration of Gunda.

Miss Jordan Lloyd described observations on the small marine triclad Turbellarian, *Gunda ulvae*, which lives in great numbers at Plymouth, between tide-marks, and near the course of a small stream. The specimens employed in the experiments were about 5·5 mm. long, and were cut transversely into two equal parts. The regeneration of the posterior region only was considered. Whole worms can live in water having an osmotic pressure between 2 and 33 atmospheres. Regulation of an anterior portion of Gunda, resulting in the production of a complete worm, takes fifty days in water having an osmotic pressure between 15 and 22·5 atmospheres (the latter being that of ordinary sea-water). Lowering the osmotic pressure below 15 atmospheres retards the rate of regulation proportionately, and below 5 atmospheres no regulation occurs. Raising the osmotic pressure above 22·5 atmospheres retards the rate of regulation, and above 30 atmospheres no regulation occurs. The new posterior region is formed by the migration of large numbers of parenchyma-cells to the region of the wound, where they aggregate and build up the new organs. Inhibition of regulation seems to be due to some factor which checks the migration of the parenchyma-cells. In examples showing retarded regulation, irregularities in the mitotic divisions of the parenchyma-cells have been noticed.

Habits and Building Organ of the Tubicolous Polychaete, Pectinaria koreni.

As the result of his observations on living Pectinaria, Mr. Arnold T. Watson considers that the process of tube-building is as follows:—A working space is first cleared, the sand around the lower, wider end of the tube, which is well below the surface, being removed by a very strong upward current, created within the tube by peristaltic action of the body-wall of the worm. This current causes the sand to pass rapidly through the tube, between it and the dorsal body-wall of the worm, and to be ejected through the small upper end of the tube, forming a mound on the surface of the sea-floor. A supply of sand is then carried by the tentacles to the head of the worm; one portion of this sand is swallowed for food and passes through the body of the worm, a second portion is carried by papillæ, which form a track from the ventral edge of the peristomium to the bilobate building organ just below, on reaching which, each grain accepted for building purposes is received and held between the two lobes. These lobes apply the sand-grain to the free edge of the tube, where it is fixed by the cement poured out by the underlying cement-gland.

Eelworms.

Mr. Gilbert E. Johnson described some of the more recent work on eelworms (Anguillulidæ), a group of microscopic round-worms which, besides purely free-living forms, includes species living saprozoically in decaying substances, while others are parasitic in animals and plants. The saprozoic forms (Rhabditis, &c.) find their nourishment and multiply rapidly among the swarms of bacteria flourishing in substances decaying in the soil and elsewhere, though whether the worms feed on the bacteria or on the products of their action is not yet known. The few species inhabiting animals, and regarded as parasites, are well exemplified by *Rhabditis pellio*, the larvæ of which inhabit the cœlom and nephridia of the earthworm. Mr. Johnson traced the life-history of this species, showing that the active forms in the nephridia, and the encysted forms in the cœlom, remain larval until the earthworm-host dies and decays in the soil. Then the eelworms feed in its decaying carcase, grow rapidly, become mature, and reproduce. When the nourishment from the dead earthworm is exhausted, the larvæ wander into the soil and infect another worm, entering by the nephridiopores into the nephridia, and by the dorsal pores into the cœlom. The larvæ entering the cœlom are attacked as foreign bodies by the amœbocytes, and encyst. It is doubtful whether the term parasite should be used for this species, since the mode of nourishment is saprozoic. Other well-known eelworms—Tylenchus, Aphelenchus, and Heterodera—pierce the cellular tissue of plants by means of the hollow stylet protrusible from the mouth-cavity, and absorb the cell-sap. There are also numerous "semiparasitic" forms, which occur round the roots of ordinary healthy plants, and apparently do no damage, but it would be interesting to ascertain what would be the result of their absence on the health of the plant.

The Larva of the Star-fish, Porania pulvillus.

Dr. J. F. Gemmill has traced the development of this star-fish. The eggs are small, and the general larval history is similar to that of *Asterias rubens*. The late larva is a brachiolaria with a well-marked sucker, and numerous small papillæ on and between the brachia. The features of special interest presented by the larvæ were:—(1) The presence, in early larvæ, of possible rudiments of a posterior enterocœlic outgrowth; (2) the occurrence, among the later larvæ, of several specimens with double hydrocœle formation; and (3) the presence, in normal and in double-hydrocœle larvæ, of a "madreporic" vesicle, the floor of which contracted rhythmically during life.

Observations on Artemia salina.

Mr. T. J. Evans recorded observations made on this Crustacean, in graded strengths of sea-salt solution from 4 to 25 per cent. It was found that the

Artemia, in 8 and 10 per cent. solutions, attained maturity without the introduction of extraneous food. The food supply was Chlamydomonas sp. in various stages of its life-cycle. The nauplius stages of Artemia die unless the brine contains a supply of free-swimming monads, but the adults live on the resting stages of the monads. The food supply present in the surface film is so great that Artemia spends much of its time feeding there, and it is probable that the habit of swimming on its back was adopted by Artemia as an adaptation for feeding in the surface film. In 4 and 5 per cent. and in 20 and 25 per cent. brine-solutions, either the eggs did not hatch or the young nauplii died as soon as the eggshell burst. Adults transferred from the optimum solutions (8 and 10 per cent.) lived in the weaker and stronger brines, and the eggs laid by them lived. It was found that eggs would hatch in any brine solution in which they had been produced. No variation of the order described by Schmankewitsch was found; the tail-lobes were of uniform size in all strengths, and possessed the same number of spines.

Pseudohermaphrodite Examples of Daphnia.

Dr. J. H. Ashworth directed attention to four abnormal female examples of *Daphnia pulex*, in each of which the antennule of one side resembled that of a male. No other male secondary sexual character was present, except that in one case the margin of the carapace presented almost the configuration of that of a male. The reproductive organs of all the specimens were normal ovaries, and were not parasitised. The offspring of two of the specimens were examined and found to be all normal.

Position of the Order Protura.

Mr. R. S. Bagnall discussed the position of the order Protura, to the "abdominal feet" of which he did not attach so much importance as some authorities have done. While recognising the affinities of the Protura to the Chilopoda, he considered the relationship with the Insecta to be closer.

Mr. Bagnall also gave a brief account of the hymenopterous parasite, *Thripoctenus russelli*, found in the larvæ of the bean thrips, *Heliothrips fasciatus*. He also recorded Thripoctenus found in association with various thrips in several English localities, and commented on the economic importance of these parasites of thrips.

Oviposition of a Fly on Centaurea.

Prof. Hickson communicated a paper by Mr. J. T. Wadsworth on the oviposition of the Trypetid fly, *Urophora solstitialis*, on *Centaurea nigra* and allied composites. This fly possesses a highly developed piercing ovipositor, which, when fully extended, is nearly twice the length of the fly. During oviposition the abdomen of the fly is pushed down between the bases of the lowest and outermost bracts of the flower-head, and the piercing portion of the ovipositor is forced downwards and inwards towards the axis of the flower-head, and then gradually bends upwards until its tip is finally in the space between the young florets and the overlying bracts, in which space the ova are deposited. The larva, after hatching, burrows through the corolla of a young floret, travels down to the ovary, and feeds there, its presence causing the growth of a "gall."

Observations on a West African Wasp.

Prof. Poulton recorded observations by Mr. W. A. Lamborn, in Southern Nigeria, on the wasp, *Synagris cornuta*, in the males of which there is remarkable difference in the grade of mandibular development. A male with very large mandibles terrorised four others with smaller mandibles, and was thus successful in capturing a female (the case being one of marriage by capture), which emerged from a nest under Mr. Lamborn's observation. Prof. Poulton suggested that the immense horn-like mandibles are a disadvantage in obtaining food and perhaps in other ways in the struggle for life, and that the emergence of the females covers a period long enough for this struggle to tell, so that the males with small or rudimentary "horns" have the advantage in the end through the operation of natural selection, while the others have the advantage at the beginning through sexual selection in the form of battles between the males.

Heredity of Melanism in Lepidoptera.

Mr. W. Bowater described experiments on various melanic Lepidoptera. He pointed out that in *Amphidasys betularia* the melanic form is now more common than the typical form, and stated that a breeding experiment seemed to point to the Mendelian dominance of melanism in this species. He also recorded the results of pairings of typical and melanic examples of *Odontoptera bidentata*. He found that distinct segregation occurred, that homozygous and heterozygous melanic forms were indistinguishable, that extracted types bred as true homozygotes, and that two heterozygous blacks, when paired, gave, in eight families, 75 per cent. black and 25 per cent. type. Mr. Bowater claimed that the specimens bred, 1800 in number, proved that melanism in this species is a simple Mendelian dominant.

Pseudacraeas and their Acraeine Models on Bugalla Island, Victoria Nyanza.

Dr. G. D. H. Carpenter found that on Bugalla Island, in the Sesse Archipelago, Victoria Nyanza, there abounds a species of Nymphaline butterfly, *Pseudacraea eurytus*, which has several forms closely mimetic of various species of the Acræine genus Planema. The 356 specimens of Pseudacræa caught by him in 1912–13 were excessively variable, intermediates between the various forms being as common as the types. Such intermediates are of the rarest occurrence on the mainland shore of the lake at Entebbe (twenty-five miles N.E. of Bugalla), but the typical forms abound there. On Bugalla Island the model Planemas are very scarce, probably from scarcity of the food-plant, so that their presence can be of little protective value to the Pseudacræas; hence any specimen which exhibits variation away from the type of the model has as much chance of escaping enemies as a form which closely resembles the model. On the mainland, however, Planemas are plentiful, so that their presence is of definite selective value for the mimics; consequently variations of the mimic are at a disadvantage in the struggle for existence, and are rarely found on the mainland, but the typical mimetic forms are abundant. It was claimed that this case afforded strong evidence of the reality of mimicry, and of the power of natural selection to keep up the mimetic likeness.

Geographical Relations of Mimicry.

Dr. F. A. Dixey pointed out that certain definite schemes of colour and pattern in the wings of butterflies are characteristic of certain definite geographical regions and even of smaller districts, and cited in illustration the well-known combination of red, black, and yellow Ithomiine, Heliconiine, Nymphaline, and Pierine butterflies in Central and South America. He remarked that it was natural to seek for an explanation in the direction of a common influence exercised by the geographical environment, but that this explanation is attended by such extreme difficulty as to be practically put out of court. The interpretation which at present holds the field is that which attributes the resemblances in colour, with their correlated geographical modifications, to the action of mimicry, either Batesian or Müllerian.

Mimicry.

Prof. Poulton opened what was intended to be a discussion on mimicry, but the opposition did not appear to be present in force, and there was not a real debate. Prof. Poulton directed attention to the injuries actually seen to be inflicted on butterflies by wild birds, and laid stress on disabling injuries, such as the loss of a whole wing or the head, indicating that the insect had not escaped, but was abandoned by the enemy. Such injuries are especially characteristic of the great groups which supply the models for mimicry, *e.g.* the Danainæ and Acræinæ in Africa. The crops of enormous numbers of birds have been examined and stated to contain no remains of butterflies, but Prof. Poulton contended that the force of this requires reconsideration in the light of the recent work of Mr. C. F. M. Swynnerton in south-east Rhodesia. Pellets thrown up by captive insectivorous birds had been collected by Mr. Swynnerton, and were exhibited at the meeting, together with examples of butterflies belonging to the same species as those devoured. These pellets, when broken up, would have come under the well-known classification, "insect débris, unrecognisable," but Mr. Swynnerton has shown that no safe conclusion as to the nature of the pellets can be drawn except after microscopic examination sufficiently minute to detect the presence of lepidopterous scales and their sockets. The objection against the origin of mimicry by small variations was met by the exhibition of mimetic females of *Acraea alciope*, from the west coast of Africa and from western and eastern Uganda. In the first series the female Acræas mimic the brown male (and in some species the female also) of the Acræine genus Planema, in eastern Uganda, they mimic the male of *P. macarista*, and the male and female of *P. poggii*, with an orange bar across the fore-wing and a white bar across the hind-wing. In western Uganda the transitional forms are found, some of the female Acræas exhibiting a pattern similar to that of the west coast form, while others show an incipient white bar across the hind-wing, but the fully formed eastern mimic is not known to occur in this locality. In the intermediate zone of country the intermediate variation is met with, connecting the western mimic with the eastern. Prof. Poulton cited examples of mimicry between the genera of certain African Nymphalines, pointed out the development of secondary resemblances between the mimics, and exhibited series of models and mimics taken in one sweep of the net in Lagos, thus showing that the mimics actually fly in the company of their models. He also showed illustrations and specimens of a few cases of mimicry in temperate North American butterflies, and pointed out what he believed to have been the evolutionary history. If this history be correct, then it is impossible to explain the resemblance as due to the influence of environment, because recent invaders from the Old World into this region have caused the mimetic modification of indigenous species. According to the theory of environment the invaders and not the residents ought to have been modified.

Prof. van Bemmelen remarked that mimetic resemblances required to be very carefully analysed. He had attempted to show that some of the patterns on the wings of butterflies were old and others new, and he suggested that some resemblances might be traceable to a pattern existing far back in phylogeny, and that the subject should be further investigated from this point of view.

Other Papers on Lepidoptera.

Sir George Kenrick discussed the classification of the Pierines, and Mr. G. T. Bethune-Baker exhibited, with the aid of the epidiascope, specimens showing changes in pattern, colour, and structure (*e.g.* the genitalia) in the Ruralidæ which lead him to conclude that pattern is very generally correlated with structure. Mr. G. D. H. Carpenter communicated observations on the enemies of "protected" insects with special reference to *Acraea zetes*. Such insects, "protected," for instance, by their distastefulness from the attacks of vertebrates, are preyed upon by predaceous insects and parasites.

The Ascidian Diazona violacea.

Prof. Herdman exhibited specimens of this compound Ascidian, which he had dredged recently in the Hebrides. When alive the colony was bright green, but when preserved in alcohol it became violet in colour. Other specimens preserved in formalin retained their green colour. Green specimens dredged from deep water changed their colour in sunlight, and finally acquired a violet tint. The green colour is not due to chlorophyll, but to an allied pigment which has been named syntethein. The green Hebridean and the violet Mediterranean form are undoubtedly the same species.

Early Evolution of the Amphibia.

Mr. D. M. S. Watson described the osteological characters of the Amphibia of Carboniferous, Permian, and Triassic formations, and concluded that, taken as a whole, the rhachitomous Amphibia of the Permian are intermediate in their structure, as they are in time between the embolomerous Carboniferous and the stereospondylous Triassic types, and it would seem that each of the three groups is to be regarded as ancestral to that which follows it. The almost absolute identity of the skulls of Pteroplax, an embolomerous Amphibian of Carboniferous type, and Seymouria, which has the most primitive skull of any known reptile, seems to show definitely that the reptiles did arrive from that group of Amphibia, presumably in early Carboniferous or Upper Devonian time. Mr. Watson suggested that the development of the bi-condylar articulation of the skull of Amphibia is to be correlated with the increasing depression of the skull, and is a characteristic Amphibian feature.

Prof. Elliot Smith referred to the difficulty presented by the Amphibian cerebral cortex in regard to the phylogeny of the mammalia. He pointed out that in Petromyzon the cerebral cortex is rudimentary, in Selachians it is more highly developed, and in Dipnoi is almost as well developed as in reptiles, but in Amphibia is degenerate and feebly efficient. But Amniota must have gone through some Amphibian ancestry. It is now evident that the retrogression of the Amphibian cortex must have taken place since the reptiles branched off the Amphibian stem.

Metamorphosis of the Axolotl.

Mr. E. G. Boulenger gave an account of the experiments which he had recently conducted on the metamorphosis of the Mexican axolotl (*Amblystoma tigrinum*). He concluded that the axolotl will, with a few exceptions, transform if placed under special conditions which force it to breathe air more frequently than usual; that starvation, irregular feeding, and temperature have no influence on the metamorphosis; that elimination of oxygen from the water has likewise no bearing on the point, as, in these circumstances, the animal will not rise to the surface and use its lungs at more frequent intervals than animals placed under normal conditions. Mr. Boulenger stated that up to a certain point only could the shrinking gills and fins of the animal be made to undergo renewed development (when transferred from shallow to deep water).

Homology of the Gills.

Prof. H. Braus described the results of a number of transplantations carried out on the larvæ of Rana, Hyla, and Bombinator by Dr. Ekman. The gill-ectoderm was detached before the gills had formed, and was transplanted to some other parts of the tadpole. Such gill-ectoderm gave rise to gill-filaments, but not to gill-clefts; circulation of the blood was also wanting, and the filaments soon perished. If the gill-ectoderm was raised, turned round through 180°, and replanted on the same area, gill-filaments were formed with circulation and gill-clefts, the latter being turned 180° from the normal position. It is concluded, therefore, that the ectoderm alone is able to produce gills, and determines their position and form, but the further development of the gills is dependent on the ingrowth of mesoderm (vascular system). "Foreign" ectoderm, *i.e.* ectoderm which under ordinary circumstances does not develop gills, behaves differently according to the part of the organism from which it is taken. That taken from the trunk or the dorsal part of the head and planted in the position of the gill-ectoderm does not give rise to gills, but if ectoderm be taken from the region above the embryonic heart and transplanted to the position of the gill-ectoderm, there are formed gill-filaments and clefts as in the normal animal. It is not yet certain what factors induce this ectoderm to imitate the gill-ectoderm, but Prof. Braus regards this imitation as of fundamental importance in relation to theories of homology.

Cultures of the Embryonic Heart.

Prof. Braus exhibited by the microkinematograph the beating heart of a tadpole (6 mm. long), which had been in the culture-medium seven days when the photographs were taken. He demonstrated the regular rhythm, about eighty beats per minute, the suspension and irregularity due to the chemical rays of light, also typical "refractory" periods, and the growth of the pigment cells. At this period of development the heart has no ganglion cells and nerves are not present, nor are muscle-cells distinguishable; it seems therefore that the protoplasmic links between the cells must be the conductors of the stimuli which pass along the heart.

Phylogeny of the Carapace and Affinities of the Leathery Turtle.

Dr. Versluys directed attention to the special characters exhibited by the carapace of the leathery turtle (*Dermochelys coriacea*), pointing out that in other Testudinata the carapace is formed by a relatively small number of plates firmly united to the vertebræ and ribs, but in Dermochelys the carapace is composed of a number of small thin plates, forming a mosaic, separated from the inner skeleton by a thick cutis. Dermochelys is not primitive, for its cervical vertebræ show that it is derived from a Cryptodiran ancestor. That this ancestor possessed the typical carapace is shown by the fact that parts of it are still found in a reduced state in Dermochelys represented by the deeper or "thecal" layer of the dermal skeleton. Prof. Dollo has maintained that the "epithecal" skeleton is a new formation, but Dr. Versluys is inclined to assume that, in the ancestors of the Testudinata, there were rows of epithecal elements (though feebly developed) beginning in the neck and continuing over the thecal shell to the base of the tail, and that the ancestors of Dermochelys reduced their heavy thecal shell and replaced it by the new mosaic shell formed by a proliferation of the marginals and other epithecal elements.

Prof. Dollo discussed Dr. Versluys's conclusions, and stated the reasons which led him still to regard the mosaic carapace of Dermochelys as an entirely new structure. He held that a study of fossil Chelonians permitted no other interpretation. He did not consider Archelon (Upper Cretaceous) as an ancestor of Dermochelys, but rather Eosphargis (Lower Eocene), because of the nature of the plastron.

In reply Dr. Versluys said that whether or not Archelon was an ancestor of Dermochelys, both possessed an epithecal mosaic carapace, of which the marginals formed part.

Unilateral Development of Secondary Male Characters in a Pheasant.

Dr. C. J. Bond exhibited the skin of the white-ringed Formosan variety of the Chinese pheasant, the plumage on the left side of which was roughly that of the adult male. The left leg showed a spur, but there was no spur on the right leg. The white-ringed neck feathers occurred in a half-circle on the left side only; the wing primaries and coverts were female in character, except for a few male feathers on the left side; the tail coverts were of the male type. A well-developed oviduct was present on the left side, and a sexual organ was in the usual position of the left ovary, but sections showed that it consisted of ovarian elements undergoing pigmentary degeneration and testicular elements in active growth. Dr. Bond pointed out that such a case presented a difficulty if the ordinary or hormonic explanation of the origin of secondary sex characters were accepted. He suggested that two factors at least are concerned in the origin and development of secondary sex characters: one, a gametic factor—the primary sex gland, and the other a somatic factor, and that the two factors may vary independently of each other under certain conditions of abnormal hereditary transmission.

A Mammal-like Dentition in a Cynodont Reptile.

Dr. W. K. Gregory exhibited, for Dr. R. Broom, upper and lower jaws of a small species of Diademodon, from a study of which Dr. Broom concludes that the Cynodonts had deciduous incisors, deciduous canines, and four deciduous premolars, exactly as in mammals. As there is no evidence, in any specimen, of a dental succession after maturity has been reached, he concludes that the two sets of teeth correspond to the mammalian milk set and permanent set.

Notharctus, an American Eocene Lemur.

Dr. W. K. Gregory exhibited a skeleton of *Notharctus rostratus*, an Eocene lemur, the discovery of several partial skeletons of which in Wyoming, by the American Museum of Natural History, affords material for a fairly complete knowledge of the skull, dentition, limbs, and vertebræ. The material shows that Notharctus is a primitive lemur, more primitive than any now living, and possibly ancestral to the Indrisine lemurs. The correspondence in the details of limbs, &c., between Notharctus and modern Lemuridæ is remarkably close, but the front teeth of the former are more primitive and have not assumed the lemurid characters; the molars are in pattern ancestral to those of Propithecus.

Dr. Gregory discussed the phylogeny of the primates, which he divided into three series:—(1) Lemuroidea, including Prolemures (Notharctidæ, Adapidæ), Lemures, and Nycticebi; (2) Pseudolemuroidea; (3) Anthropoidea. The Prolemures are the lowest and most generalised, and contain the ancestors of the Lemuridæ and Indrisidæ. Nesopithecus and other ape-like lemurs with enlarged brain-case are closely allied to the Indrisidæ, and their resemblances to the Anthropoidea are demonstrably convergent, not genetic. The oldest known platyrrhine, Homunculus, of the Patagonian Santa Cruz formation, is definitely a Cebid. The oldest Anthropoidea are those described by Schlosser from the Upper Eocene of Egypt, and they show no special approach to the platyrrhines. The Hominidæ are linked securely with the Simiidæ, not only by the abundant evidence of anatomy and physiology, but also by recent palæontological discoveries.

Morphology of the Mammalian Tonsil.

Miss M. L. Hett gave an account of the principal types of tonsil found in mammals. Tonsils are normally present, and do not atrophy until extreme old age (except in man), in most of the mammalian orders, but they are wanting in many rodents, some insectivores, and most bats. The gross anatomy of the tonsils is very distinctive for each group of mammals, being always characteristic of the order, and frequently also of the family, or even, in some cases, of the genus. Miss Hett remarked that it was not easy to show, in the case of this organ, an actual correlation between structure and habit, but it was worthy of note that the tonsils of carnivorous marsupials bear a remarkable resemblance to those of Eutherian carnivores.

Several other papers were read, which, however, do not lend themselves to the purpose of a summary. Prof. Poulton pointed out that the term mutation has been employed in three different senses, and suggested that it should be restored to its original use and that new terms be employed for the other two uses of "mutation," and for the two kinds of "fluctuation." Mr. R. H. Whitehouse discussed the evolution of the caudal fin of fishes, and the morphology of the elements of the fin. Prof. R. J. Anderson presented notes on the skull and teeth of Tursiops and on the skeletal elements of vertebrate limbs; the Rev. Dr. Irving exhibited teeth and limb bones of the Solutré type of horse from the Stort valley; Mr. Forster Cooper gave an account of Thaumastotherium, a new genus of Perissodactyles; Dr. W. S. Bruce exhibited a series of photographs of the new zoological gardens near Edinburgh, and Mr. F. Coburn submitted observations on the migration of birds over the midland district.

By the courtesy of Major C. C. Hurst, about eighty members of Sections D, K, and M were invited to inspect the Burbage Experimental Station for applied genetics. Attention was particularly directed to six series of exhibits, of each of which Major Hurst gave a brief explanation and demonstrated the special features shown:—(1) garden races of Antirrhinum, illustrating the inheritance of minute variations in tint, height, and habit of growth; (2) segregation of specific characters in F_2 hybrids of Berberis; (3) breeding experiments with racing pigeons, with the view of investigating the transmission of homing powers; it is interesting to note that feeble-mindedness behaves as a recessive in birds; (4) breeding experiments with Dutch rabbits, with respect to the inheritance of coat-colour and markings; (5) the colt of a pure-bred shire mare and a thoroughbred stallion; (6) breeding experiments with poultry, which suggest that both the male and female parents transmit to their daughters factors for egg-size and egg-colour, that the smaller grade egg is dominant to the larger grade, and the darker tint dominant to the lighter.

J. H. ASHWORTH.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In a paragraph last week (p. 362) it was stated that the number of students receiving instruction in the school of agriculture was 320. Prof. T. B. Wood, Drapers Professor of Agriculture, informs us that the correct number is about one-third of that stated. The mistake arose by adding together the number of students in each of the three terms.

THE Swiney lectures on geology in connection with the British Museum (Natural History) will be given this year by Dr. T. J. Jehu, his subject being "The Natural History of Minerals and Ores." The lectures will be delivered in the Metallurgical Lecture Theatre of the Imperial College of Science and Technology, Exhibition Road, South Kensington, on Mondays and Tuesdays, at 5 p.m., and Saturdays at 3 p.m., beginning Saturday, November 29, and ending Tuesday, December 23. Admission to the lectures is free.

IT is announced in *Science* that complete plans for the new home of the Massachusetts Institute of Technology have now been made public. There are to be nine contiguous buildings, each devoted to a separate department. Building operations have already been started. The principal buildings are expected to be ready for occupancy in two years. Of the 2,000,000*l.* necessary, 1,460,000*l.* has been already promised. From the same source we learn that the Chamber of Commerce of New York City has received a gift from a donor whose name is withheld of 100,000*l.* for a building for a college of commerce. Gifts have also been received of 10,000*l.* from four other subscribers. The Chamber of Commerce proposes to provide a building and to install a commercial and civic museum on condition that the City of New York provides the working expenses.

THE conditions of admission to the new Register of Teachers were approved finally at the meeting of the Teachers' Registration Council held on November 21. The conditions of registration are set out in the text of the regulations which was published in full in *The Times* of November 22. The register will contain the names of all registered teachers in alphabetical order in one column, with the date of registration, and a further statement of attainments, training, and experience. Among the conditions approved under which entries may be made on the register the following may be mentioned:—The candidate must have obtained one of a number of the qualifications specified, produce satisfactory evidence of having completed successfully a year's course of training, and of having had a three years' period of experience as a teacher. In addition, applicants must be twenty-five years of age, and pay a fee of one guinea. Teachers not satisfying these conditions may, up to December 31, 1918, apply for registration if they have had five years' approved experience of teaching, or ten years' not mainly or solely employed in teaching. The period of experience will be reduced if evidence of a year's training can be given. The certificate of registration is valid for nine years, and can then be renewed without fee.

WE have received an interim report of the Book Production Committee of the Library Association.

The inquiries of the committee began in 1905, and have resulted in the formulation of a number of recommendations, which, however, are published as "under revision." With most of the recommendations all who have to use books will cordially agree. Thus the committee advise that the title-page should be dated in the case of all copyright books with the dates of previous impressions on the back or on the half-title. Each book should contain a list of contents and an index, and the headlines should be descriptive of the contents of the page. One of the most important and difficult parts of the inquiry related to the quality of the paper used in books, and a classification into four types was adopted: (1) papers of light, spongy character, or featherweight; (2) printing papers with a moderate finish or surface, containing not more than 15 per cent. mineral matter; (3) highly surfaced printing papers; (4) so-called "art" papers surfaced on both sides with mineral matter. Class (2) is recommended for books intended to resist a normal amount of wear, papers in classes (1) and (4) being quite bad from the point of view of durability. Class (3) is a compromise between (2) and (4), and the committee evidently prefers to use class (2) for reading matter and for illustrations also where the use of half-tone blocks can be avoided. When the illustrations are of a kind which demands a surfaced paper, "it seems reasonable to suggest that the letterpress should be printed on ordinary paper and the illustrations on a thin art paper coated on one side only, the illustrations being guarded into the book." There are recommendations with reference to printing, book-illustration, and binding, and the report is the result of careful work by experts in the subjects dealt with. The establishment of the London County Council classes in book production was an indirect result of their earlier labours, and we shall look forward to a further report, when we hope that the question of legibility will receive more consideration, especially the influence upon eyesight of the surface, thickness, and texture of the paper used for printing.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 20.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. D. H. **Scott**: *Medullosa pusilla*. Medullosa is a genus of fossil plants, with structure preserved, from the Carboniferous and Permian. Only one British species has so far been known, *Medullosa anglica*, from the Lower Coal Measures, the oldest and simplest member of the genus, with three uniform vascular cylinders. *Medullosa pusilla* from Colne, Lancs., is a closely allied form of remarkably small size and somewhat simplified structure.—Prof. A. F. S. **Kent**: Neuro-muscular structures in the heart. The paper deals with the relations of the structures at the auriculo-ventricular junction. Nerve fibres and nerve cells, the exact functions of which are open to conjecture, are numerous in the neighbourhood of the junction. The present work shows that these nervous elements are associated with structures which lie in the connective tissue between the auricular muscle and the ventricular muscle.—George **Graham** and E. P. **Poulton**: The alleged excretion of creatine in carbohydrate starvation.—J. A. **Gardner** and P. E. **Lander**: The origin and destiny of cholesterol in the animal organism. Part xi., The cholesterol content of growing chickens under different diets.—W. E. **Bullock** and W. **Cramer**: Contributions to the biochemistry of growth—the lipoids of transplantable tumours of the mouse and the rat.

Physical Society, November 14.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—H. R. **Nettleton**: The thermal conductivity of mercury by the impressed velocity method. The paper gave an account of the determination of the thermal conductivity of mercury at the ordinary temperature of the room by the impressed velocity method first described by the author in the Proceedings of this society, vol. xxii., 1910. A mean value of 0·0201 c.g.s. units at 15·5° C. is obtained for the thermal conductivity.—Dr. A. W. **Ashton**: Polarisation and energy losses in dielectrics. The object of the paper is to discuss the relations which should exist between the coefficients in Pellat's equation (as modified by Schweidler), giving the displacement in a viscous dielectric as a function of the time of charge and the P.D.—F. J. **Harlow**: A lecture experiment to illustrate ionisation by collision and to show thermo-luminescence. A method of demonstrating to an audience both ionisation by collision and the reduction of the sparking potential by the presence of initial ionisation is described in the paper.

PARIS.

Academy of Sciences, November 17.—M. F. Guyon in the chair.—Charles **Moureu** and Emile **André**: The thermochemistry of acetylene compounds. The heats of combustion and formation of thirty-three acetylene derivatives have been determined, and compared with the analogous ethylene and saturated compounds. The addition of a molecule of hydrogen to acetylene derivatives evolves about 80 calories in the fatty series, rather less in the aromatic series.—A. **Laveran**: Macacus and dogs are affected similarly by Indian and Mediterranean kala-azar. An experimental proof of the identity of these two diseases.—Georges **Charpy** and André **Cornu**: The influence of silicon on the solubility of carbon in iron. As the silicon increases, the solubility of carbon in iron decreases, becoming practically nil at 900°, for 4 per cent. silicon, and at 1000° C., with 7 per cent. of silicon.—M. **Gosselet** was elected a non-resident member.—M. **Giacobini**: The return of the Giacobini comet (1900 III.). The comet 1913*e* is shown to be identical with the Giacobini comet (1900 III.).—E. **Keraval**: A family of triply orthogonal systems.—M. **Tzitzéica**: Conjugated networks.—Zoárd de **Geöcze**: The quadrature of varieties.—Kampé du **Fériet**: The ultraspherical polynomials $V^{(s)}_{m_1 \ldots m_p}$.—Léon **Brillouin**: The propagation of a luminous signal in a dispersive medium.—Pierre **Weiss** and Auguste **Piccard**: The magnetisation of nitric oxide and magneton. E. **Ariès**: Remarks on the coefficients of thermo-elasticity.—M. **Billon-Daguerre**, L. **Medard**, and H. **Fontaine**: A new arrangement of the mercury lamp. A description of a quartz mercury-vapour lamp, giving about 3000 candles for an expenditure of 1250 watts. The lamp causes practically no heating effects, and the light can be condensed on a celluloid film without danger. The point of light is absolutely fixed, and requires no adjustment in use.—G. **Moreau**: Electric couples in flames. An account of some electrical effects noticed when two platinum plates, one bearing a trace of a salt and the other clean, are heated together in a flame.—M. de **Broglie**: A new method giving photographs of line spectra with Röntgen rays.—F. O. **Germann**: Revision of the density of oxygen. The density of the air of Geneva. The oxygen in these experiments was prepared by heating potassium permanganate, passed over solid potash, phosphoric anhydride, and mercury, and further purified by fractional distillation. Using four different density globes, eleven observations gave a mean density of 1·42904 (extremes 1·42815 and 1·42941). A second set, in which the oxygen was not distilled, gave a mean value 1·42923; a third set, similar treatment to first series, but gas passed in addition over heated platinised asbestos, gave 1·42905. The final mean of the fifteen observations of the first and third series was 1·42906.—Eug. **Wourtzel**: The decomposition of hydrogen sulphide by the radium emanation. The amount of gas decomposed was studied with respect to the effects of temperature and pressure.—Paul **Pascal**: Complex salts of uranium.—N. D. **Costeanu**: The action of carbon dioxide upon boron sulphide. The reaction was found to correspond to the equation

$$B_2S_3 + 3CO_2 = B_2O_3 + 3CO + 3S.$$

—Albert **Granger**: The colorations arising in glasses containing copper. A satisfactory blue colour is obtained in a glass containing only 0·05 CuO for one molecule of the base. A larger proportion of copper gives a greenish shade, especially in glass with a high proportion of alkalies.—F. **Bodroux**: The catalytic esterification in aqueous solution of some primary alcohols of the $C_nH_{2n+2}O$ series.—H. **Mech**: The products of condensation of the nitro-benzyl chlorides with acetylacetone, methylacetylacetone, and the cyanacetic esters.—Roger **Douris**: The action of mixed organo-magnesium derivatives upon the dimeric aldehyde from crotonaldehyde.—MM. **Desgrez** and **Dorléans**: The antagonism of the properties of guanine and adrenaline. The toxicity of adrenaline is diminished to a certain extent by the action of guanine, the adrenalinic glycosuria being notably reduced.—R. **Fosse**: The identification of urea and its precipitation in extremely dilute solutions. The reagent proposed is xanthydrol. This precipitates dixanthylurea, of high molecular weight. In a solution containing one-millionth part of urea, 0·01 mgr. can be detected microscopically. From 0·03 to 0·05 gram of urea can be separated and identified by analysis. Details of the technique are given.—Henri **Piéron**: The mechanism of the chromatic adaptation of *Idotea tricuspidata*.—Albert **Michel-Lévy**: The limiting age of the granite in the Mâconnais and Beaujolais mountains.—O. **Mengel**: The eastern termination of the synclinal of Mérens-Villefranche.—G. **Depape**: The presence of *Ginkgo biloba* (*Salisburya adiantifolia*) in the Lower Pliocene of Saint-Marcel-d'Ardèche.—Arthur L. **Day** and E. S. **Shepherd**: Water and magmatic gases. It has been stated that the gases emitted by the crater of Kilauea do not contain water. Gas samples were taken directly from a lava fountain at the bottom of the crater, and proved to contain steam in considerable quantity, in addition to large proportions of sulphur dioxide and carbon dioxide. Carbon monoxide, hydrogen, and nitrogen were also present in these gases. Analyses are also given of the solid matter contained in the water deposited from the gas samples.

Cape Town.

Royal Society of South Africa, October 15.—The president in the chair.—R. **Marloth**: A new mimicry plant (*Mesembrianthemum lapidiforme*). In summer the plant consists only of two fleshy bodies (the leaves), which are half buried in the sand. Each leaf is about 1 in. to 1½ in. in length and width, shaped like a tetrahedron with blunt edges and angles, and brownish-red in colour, like the angular fragments of stone among which the plant grows. It is consequently very difficult to detect even in localities where its occurrence is known. In spring the plant produces two flowers, one at each side, which are joined to the parent plant by a very thin connection. The ripe seed vessel is consequently easily detached at this spot and can be carried away by the wind—a mode of dispersal unique among the nearly 400 species of the genus Mesembrianthemum. The plant was discovered in the Ceres Karoo by Capt. Edward Alston.—J. P. **Dalton**: An experimental modification of van der Waals's equation. The a of van der Waals's equation is considered to be a function of the temperature only, and the b to be independent of the temperature. The function is then determined for a typical normal substance (*iso*pentane) from the experimental isothermals, and it is shown that the law $\log a = \alpha + \beta T$ is accurately obeyed. The equation is modified accordingly. The new saturation constants are obtained, and the modified vapour pressure curve is found to represent experimental results for both normal and abnormal substances much more closely than the original. The new values agree well with the van der Waals vapour pressure formula, and the value of the constant at the critical point is practically equal to that which is given by carbonic acid and by *iso*pentane. The modified equation is also used with quite satisfactory results for the calculation of latent heats and also for obtaining the curve of inversion of the specific heat of saturated vapours.—J. R. **Sutton**: Barometric variability at Kimberley and elsewhere. An attempt to determine working constants which shall represent the "cylonic activity" at various places in South Africa and such other places outside as have available information regarding the barometer. Tables are given showing the monthly mean constants, with maximum and minimum values, or barometric variability. One deduction is that the "equinoctial gales," so far as barometric changes can represent them, have no existence in fact.

BOOKS RECEIVED.

Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditerranée. By C. Houard. Tome Troisième. Supplément 1909–12. Nos. 6240 à 7556. Pp. 1249–1560. (Paris: A. Hermann et Fils.) 10 francs.

Die Stammesgeschichte der höheren Pflanzen. By Dr. W. Breitenbach. Pp. 77. (Brackwede i.W.: Dr. W. Breitenbach.) 1.50 marks.

Vergleichende Physiologie und Morphologie der Spinnentiere unter besonderer Berücksichtigung der Lebensweise. By Prof. F. Dahl. Erster Teil. Pp. vi+113. (Jena: G. Fischer.) 3.75 marks.

Handbuch der Vergleichenden Physiologie. Edited by H. Winterstein. Band iii. Erster Heft. (Jena: G. Fischer.) 5 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. 62 and 63 Lief. (Jena: G. Fischer.) 2.50 marks each Lief.

The Romance of the Newfoundland Caribou. By A. A. Radclyffe Dugmore. Pp. viii+191+plates. (London: W. Heinemann.) 12*s*. 6*d*. net.

The Waters of the North-Eastern North Atlantic: Investigations Made During the Cruise of the *Frithjof*, of the Norwegian Royal Navy, in July, 1910. By F. Nansen. Pp. 139+xvii plates. (Leipzig: Dr. W. Klinkhardt.)

The Nummulosphere. By R. Kirkpatrick. Part 2. The Genesis of the Igneous Rocks and of Meteorites. Pp. xv+plate. (London: Lamley and Co.) 1*s*. net.

Principles and Methods of Teaching Geography. By F. L. Holtz. Pp. xii+359. (London: Macmillan and Co., Ltd.) 5*s*. net.

Practical Surveying and Elementary Geodesy. By Prof. H. Adams. Pp. xii+276. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*.

Manures and Fertilizers. By Dr. H. J. Wheeler. Pp. xxi+389. (London: Macmillan and Co., Ltd.) 7*s*. net.

Lepidoptera Indica. By Col. C. Swinhoe. Part cxxii. Pp. 313–336+plates. part cxxiii. Pp. 337–364+x. (London: L. Reeve and Co., Ltd.) 10*s*. plain; 15*s*. coloured; and 15*s*. respectively.

Die Oekologie der Pflanzen. By Dr. O. Drude. Pp. x+308. (Braunschweig: F. Vieweg und Sohn.) 10 marks.

A National System of Education. By J. H. Whitehouse. Pp. 92. (Cambridge University Press.) 2s. 6d. net.

Smithsonian Miscellaneous Collections. Vol 61, No. 1, The White Rhinoceros. By E. Heller. Pp. 77+31 plates. (Washington: Smithsonian Institution.)

Annual Report of the Board of Regents of the Smithsonian Institution for the Year Ending June 30, 1912. Pp. xii+780+plates. (Washington: Government Printing Office.)

Text-Book of Paleontology. Edited by Prof. C. R. Eastman. Adapted from the German of Karl A. von Zittel. Second edition, revised and enlarged. Vol. i. Pp. x+839. (London: Macmillan and Co., Ltd.) 25s. net.

The Snakes of Europe. By Dr. G. A. Boulenger. Pp. xi+269+xiv plates. (London: Methuen and Co., Ltd.) 6s.

A First Numerical Trigonometry. By W. G. Borchardt and the Rev. A. D. Perrott. Pp. xi+159+xvii+xvii. (London: G. Bell and Sons, Ltd.) 2s. 6d.

Icones Orchidearum Austro-Africanarum Extra-Tropicarum; or, Figures, with Descriptions of Extra-Tropical South African Orchids. By H. Bolus. Vol. iii. Pp.+plates 1–100. (London: W. Wesley and Son.)

Die Atome. By Prof. J. Perrin. Mit Autorisation des Verfassers Deutsch herausgegeben von Dr. A. Lottermoser. Pp. xx+196. (Dresden and Leipzig: T. Steinkopff.) 5 marks.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 27.

ROYAL SOCIETY, at 4.30.—A Method of Measuring the Pressure Produced in the Detonation of High Explosives or by the Impact of Bullets: Prof. B. Hopkinson.—Gravitational Instability and the Nebular Hypothesis: J. H. Jeans.—The Diffraction of Light by Particles comparable with the Wave-length: B. A. Keen and Prof. A. W. Porter.—Note on the Colour of Zircons, and its Radio-active Origin: Prof. R. J. Strutt. The Influence of the Constituents of the Crystal on the Form of the Spectrum in the X-ray Spectrometer: Prof. W. H. Bragg.—The Analysis of Crystals by the X-ray Spectrometer: W. L. Bragg.—Ship Resistance: The Wave-making Properties of Certain Travelling Pressure Disturbances: Dr. T. H. Havelock.—The Mathematical Representation of a Light Pulse: Dr. R. A. Houstoun.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Characteristics of Insulation Resistance: S. Evershed.

CONCRETE INSTITUTE, at 7.30.—The Differential and Integral Calculi for Structural Engineers: W. A. Green.

FRIDAY, NOVEMBER 28.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Patent Protection: A. Abbey.

PHYSICAL SOCIETY, at 5.—The Expansion of Silica: Prof. H. L. Callendar.—The Thermal Expansion of Mercury and Fused Silica: F. J. Harlow.—An Experimental Method for the Production of Vibrations on Strings, Prof. J. A. Fleming.—A Double-fibre String Galvanometer: W. Apthorpe.

SATURDAY, NOVEMBER 29.

ESSEX FIELD CLUB (at the Essex Museum of Natural History, Stratford) at 6.—Autumn Botany at Clacton: C. E. Britton.—Report of Club's Delegate at the Meeting of the British Association at Birmingham, 1913: J. Wilson.—A Demonstration on the Nano-Plankton of Freshwater Ponds and Lake, as Revealed by the Use of the Centrifuge: D. J. Scourfield. The Occurrence of Rhaxella-chert in the Epping Forest Gravels: P. G. Thompson.—Notes on the Plant-seeds found during Excavation of the Romano-British Barrow on Mersea Island: S. Hazzledine Warren.

MONDAY, DECEMBER 1.

SOCIETY OF ENGINEERS, at 7.30.—The Corrosion and Rusting of Iron: E. K. Rideal.

ARISTOTELIAN SOCIETY, at 8.—Feeling: Prof. J. A. Smith.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Use of Antiseptics for Soil Sterilisation Purposes: Dr. E. J. Russell and Mr. Buddin.

ROYAL SOCIETY OF ARTS, at 8.—Cantor Lecture—The Measurement of Stresses in Materials and Structures: Prof. E. G. Coker.

TUESDAY, DECEMBER 2.

RÖNTGEN SOCIETY, at 8.15.—Sterilisation of Milk by Electrified Gas: Dr. Hampson, Prof. W. G. Duffield, and T. Murray.—Radium-emanation Applicators: C. E. S. Phillips.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Japanese Minor Magic connected with the Propagation and Early Infancy of Children: W. L. Hildburgh.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Transandine Railway: B. H. Henderson.

WEDNESDAY, DECEMBER 3.

AERONAUTICAL SOCIETY, at 8.30.—The Coming Airship: Captain C. M. Waterlow.

GEOLOGICAL SOCIETY, at 8.—(1) A Contribution to our Knowledge of the Geology of the Kent Coalfield; (2) The Fossil Floras of the Kent Coalfield: Dr. E. A. Newell Arber.

ROYAL SOCIETY OF ARTS, at 8.—Perfumery: J. C. Umney.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Sulphuretted Hydrogen from Artificial Graphite: W. H. Woodcock and B. Blount.—The Determination of Strychnine in the Presence of Quinine: C. Simmonds.—The Rate of Liberation of Hydrocyanic Acid from Linseed: S. Collins and H. Blair.—The Composition of Palm-Kernel Oil: G. D. Elsdon.

ENTOMOLOGICAL SOCIETY, at 8.—New South American Butterflies: W. F. H. Rosenberg and G. Talbot.

THURSDAY, DECEMBER 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: (1) A Method of Studying Transpiration; (2) The Effect of Light on the Transpiration of Leaves: Sir Francis Darwin.—Dimensions of Chromosomes considered in Relation to Phylogeny: Prof. J. B. Farmer and L. Digby.—The Process of Calcification in Enamel and Dentine: J. H. Mummery.—The Optimum Temperature of Salicin Hydrolysis by Enzyme Action is Independent of the Concentrations of Substrate and Enzyme: A. Compton.—The Ratio between Spindle Lengths in the Spermatocyte Metaphases of Heliae Pomatia: C. F. U. Meek.—Egyptian Blue: Dr. A. P. Laurie, W. F. P. McLintock and F. D. Miles.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electricity Supply in Large Cities: Dr. G. Klingenberg.

LINNEAN SOCIETY, at 8.—Wild Wheat from Mount Hermon, *Triticum dicoccoides* Koern: Prof. J. Percival.—Neurotes, a New Genus of Mymaridæ, from Hastings: F. Enock.—A Contribution to the Study of the Evolution of the Flower; with Special Reference to the Hamamelidaceæ, Caprifoliaceæ and Cornaceæ: A. S. Horne.—The Mollusca of the River Nile: Mrs. Longstaff.

FRIDAY, DECEMBER 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Thomas Hawksley Lecture: Water as a Mechanical Agent: E. B. Ellington.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Presidential Address: Sir Boverton Redwood, Bart.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Liverpool Street Extension of the Central London Railway: H. V. Hutt.

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, DECEMBER 4, 1913.

ANTARCTIC METEOROLOGY.

National Antarctic Expedition, 1901–1904. *Meteorology*. Part ii. Comprising Daily Synchronous Charts October 1, 1901, to March 31, 1904. Prepared in the Meteorological Office, under the superintendence of M. W. Campbell Hepworth, C.B. Pp. 26 + charts. (London: The Royal Society, 1913.) Price 21s.

THIS work completes the series of meteorological investigations which were begun after the return of the National Antarctic Expedition in the year 1904. While the first volume, which appeared in the year 1908, dealt with the meteorological observations of the *Discovery* station and of the sledge journeys carried out from there, the second volume now published gives the results of the International Meteorological Cooperation, which existed from 1901 to 1904, in order to discuss, in a summarised form, the weather conditions of the higher southern latitudes during that period of investigation. For this purpose it was from the first arranged, at the instigation of the German authorities, to construct daily synoptic weather charts of the higher southern latitudes for the period October 1, 1901—March 31, 1903. The data for these charts were to be supplied by the land stations on the southern continents, and by ships of all nationalities which were during that time further south than 30° S. latitude. These were requested to take observations daily at the time of Greenwich noon, relating to air-pressure, temperature of the air and sea, amount and motion of clouds, precipitation, and other noteworthy phenomena.

As the ship *Discovery* remained fixed in the ice a second year, it was agreed to extend the International Cooperation for another year, viz., to March 31, 1904. The data thus obtained, which covered a period of two and a half years, were, after the termination of the cooperation, collected at the Meteorological Office in London, and at the Bureau of the German South Polar Expedition in Berlin, and at both places the plan of constructing weather charts was then further considered. The result of the English discussion, prepared under the superintendence of Commander Hepworth, is contained in the volume now under review. The German discussion, which was handed over by the leader of the German South Polar Expedition, Dr. von Drygalski, to myself and Mr. Mecking, is under publication. A first part, which dealt with the monthly isobaric charts from October, 1901, to March, 1904, and the climatic conditions of Cape Horn, was published in the summer of 1911. The continuation in the course of next year will include the daily synchronous weather charts, together with their discussion.

In the work under review the weather charts of the south polar region are drawn on the polar projection on the scale of about 1 : 130 millions for the period in question. Of the elements relating to the weather only wind-direction and force, air-pressure (without correction for gravity), air-temperature at individual stations, and at the ships' positions, are given; not sea-temperature, cloud, and hydrometeors, which are probably omitted for want of space. With the aid of air-pressure and wind observations, isobars are drawn, but are apparently limited essentially to simultaneous observations at Greenwich noon only, without regard to changes of weather from day to day. Consequently the run of the isobars on the charts between positions of far-distant ships is practically disconnected and uncertain. By the addition of the regular four-hourly ships' observations a much better basis for drawing the isobars might have been obtained; this will be done in the German publication.

It is also noticeable that the isobars between neighbouring places of observation are not brought into harmony and connection, which in many cases might have been easy, and would appear to be necessary. Compare, for instance, the isobars of November 4, 1902, southward of Australia and eastward of South America. In these circumstances one could not, in most cases, accurately locate "High" and "Low" on the charts and identify them from day to day. It therefore seems hazardous to use the charts for systematic investigations relating to the velocity of translation of anti-cyclones and cyclones. In the brief text which accompanies the charts, the author has restricted himself to noting the amount of progression of nine depressions only, which could be identified on the charts after about every eight days. From these he has drawn the following conclusion:—"If the centres of the respective cyclonic depressions have been correctly located, the average daily rate at which they progressed was nearly 300 nautical miles."

As regards anticyclones the case was only more favourable in the area of the Australian and South American continents. But there is no detailed information in the text as to what new results could be deduced from the charts in question; generally speaking only the older investigations of Hepworth, Russell, Lockyer, and Rawson are referred to, and the general remark made that the views of the first-named are confirmed by the new publication. Commander Hepworth especially objects to Russell's deduction that the southern sub-tropical anticyclones have a daily west-east movement of 460 nautical miles; this figure is thought to be much too high, and not confirmed by ships' observations. It would appear more likely that the depressions travelled quickly, and determined the alternation of weather conditions on the south border of the sub-tropical anticyclones, the movements of which, according to the weather charts, are shown to be erratic and slow.

The average paths followed by the depressions are, so far as possible, deduced from the daily charts and entered on unpublished charts. Unfortunately, only general information on the results of this investigation is contained in the text to the atlas. The following are the principal conclusions:—

"The average path of all central areas of depressions charted for the entire period, October, 1901, to March, 1904, is found to have been in about the 52nd parallel. Between the meridians of 20° E. and 150° E., that is to say, over the South Indian division of the Southern Ocean, it was between the 49th and 50th parallels; and between 150° E. and 70° W., the South Pacific division, in about the 55th. . . During the summer months the 53rd was the average parallel along which the centres travelled eastward in the Indian division, and they followed a path between the 56th and 57th in that of the Pacific. During autumn and winter the paths were confined to zones between 48° S. and 49° S. in the South Indian division, and between 55° and 56° S. in the Pacific."

For the south-western Atlantic Ocean it is shown that the paths of the depressions eastward of 56° W. take the direction towards E., S.E., or N.E. In autumn and winter the paths in all parts of the Southern Ocean are more scattered than in spring and summer. But, in my opinion, these statements of the mean geographical latitude of the tracks require an essential limitation. It is plainly not a question of the paths of the *centres* of the depressions as there stated. Moreover, in the circumstances, the determination of these centres in the Southern Ocean was really not possible, as the range of the area of weather charts in the Indian and Pacific Ocean does not extend far enough to the south. In the Indian Ocean vessels rarely go beyond 50°, or in the Pacific Ocean beyond 55° S.

On the charts, so far as these latitudes, the isobars in low-pressure regions usually show no closed form; on the contrary, they are open towards the south, a sign that the centres of the depressions usually lie more southerly than those latitudes. In fact, it is already known from the observations of the South Polar expeditions that the zone of west winds has its southerly limit beyond 60°, and consequently the mean paths of the depressions are also to be looked for in this high latitude. The writer has determined this latitude as 63° S. for the meridian of the *Gauss* station (90° E.). South of Cape Horn, 62° S. may be assumed, while eastwards in the Weddell Sea the depressions draw still more to the southward. The latitudes above indicated, therefore, only refer to those northerly offshoots of the depressions which extend to the regions represented by synoptic charts, and which often have the character of secondary depressions. As a matter of fact, therefore, those figures furnish no answer to the important question as to where the depressions of the southern temperate zone are to be looked for. On this point only the discussion of the results of the synchronous South Polar Expeditions, in conjunction with the weather charts, can give information.

In the text accompanying the charts the results of the expeditions are only referred to briefly. The author there restricts himself essentially to some general remarks on the character of the easterly winds at the south polar stations. He rightly holds them to be of cyclonic origin, which agrees with the writer's views in the discussion of the wind observations at the *Gauss* station (1905), and subsequently stated in more detail. And the warm, stormy, south-easterly winds at the *Discovery* station are also indicated as cyclonic air-currents, which bring their warmth and moisture with them from low latitudes. The occurrence of corresponding storm periods at the Kerguelen and *Gauss* station is shown in twelve cases, proving that a connection exists between them, as had also been remarked by the writer. The publication of hourly observations at both stations in the German South Polar work allows the comparison to be still more thoroughly and forcibly demonstrated.

In the discussion of the weather conditions of the Weddell Sea, the important investigations of Mossman and Mecking were certainly worthy of being mentioned. The explanatory text of the work now in question contains in the smallest space only general facts about those conditions which have long been known and fully established by the investigators named.

In addition to the daily weather charts there are monthly charts of air-pressure and air-temperature for the period in question (October, 1901—March, 1904), and opposite to these are placed the normal charts for comparison. From these some general conclusions are drawn upon the deviations of the individual seasons and years, but without detailed comparison; and a precise account of the method on which these monthly charts are drawn is not given in the text. The monthly isobaric charts published by the German South Polar Expedition, and partly discussed in detail, are not referred to.

The daily weather charts are also utilised in determining the frequency of winds and storms in the different 10° zones of latitude; these are given in tabular form, but no conclusions are drawn from them.

In the preface to the volume the president of the Royal Society, Sir Archibald Geikie, makes some very useful corrections to volume i. of the Meteorology of the National Antarctic Expedition. These refer specially to the question whether on the sledge journeys of the *Discovery* expedition the wind-directions were noted by true or magnetic bearings.

W. MEINARDUS.

THE GROUP-ORIGIN OF SPECIES.

Gruppenweise Artbildung, unter spezieller Berücksichtigung der Gattung Oenothera. By Prof. Hugo de Vries. Pp. viii + 365 + 22 coloured plates. Figs. 121. (Berlin: Gebrüder Borntraeger, 1913.) Price 22 marks.

IT may be said at once that the facts in this volume represent perhaps the most compendious and extensive experimental treatment of hereditary phenomena which has yet been accomplished in one limited group of organisms, and as such it deserves careful study by all students of genetics. The book is an outgrowth and further development of the views expressed by de Vries in "Die Mutationstheorie" (1901–03). Those views were, as is well known, founded chiefly upon the author's experiments with Oenothera, the mutation theory of sudden germinal changes being also based to some extent upon his conception of intracellular pangenesis.

The present volume, therefore, marks not only an important advance in our knowledge of the hereditary behaviour in the evening primroses, but also coordinates, and develops to a remarkable degree the views of the author on the general subject of heredity and its relation to mutation. The strength of this present work lies in the fact that the new empirical results all receive their interpretation in terms of the earlier theory. And it must be said that the enormous mass of experimental data with Oenothera has been coordinated and rendered intelligible in a striking way by the application of the author's earlier conceptions.

De Vries adheres to the view that characters which are independently inherited must be represented by separate structures (pangens) in the cell, and one of the basic conceptions of the book is that these pangens are not simply present or absent from the cell, but may exist in one of three conditions: (1) active, (2) inactive, or (3) labile. On this basis the whole explanation, not only of several different types of hereditary behaviour in wild species and mutants, but also of the mutation phenomena themselves, is worked out. A theory which can bring into harmonious relation such a vast body of evidence is of much service, even though its validity may not be final.

Since the phenomena of heredity occupy such an important part of the book, a few of the general results of crossing may be mentioned. By series of interspecific crosses it is shown that various wild species, including *O. biennis* L., *O. muricata* L., and *O. cruciata* Nutt., carry entirely different characters in their male and female germ cells. Such species are called heterogamous. The pollen grains usually carry a type corresponding nearly with the external characters of the species, while the egg cells may carry a very different type. Other species of Oenothera, such as *O. Hookeri*, *O. strigosa*, and *O. Lamarckiana*, are, like most wild species, isogamous, *i.e.*, bearing the same qualities in their eggs and pollen grains. In heterogamous species the reciprocal crosses are, of course, unlike.

In the subsequent crosses, several distinct types of hereditary behaviour are recognised, *e.g.* (1) twin hybrids—two types unlike either parent, and which subsequently breed true or split, being produced in the F_1; (2) the formation of intermediate hybrids, which remain constant; (3) splitting in F_1 into the two parent types, which afterwards breed true; (4) Mendelian splitting, in F_2. The mutations from *O. Lamarckiana* are thus classified according to the type of behaviour they exhibit.

These types of behaviour again are discussed in terms of pangens. Why, for instance, does *O. Lamarckiana* × *O.* mut. *nanella* give dwarfs in the F_1, while in *O.* mut. *rubrinervis* × *O.* mut. *nanella* dwarfs first appear in F_2? This is because the former cross represents a labile × inactive pangen, while in the latter we have the active × inactive condition. In this way many of the hereditary peculiarities of the Oenotheras are "explained" by the same theory which explains the mutations themselves. It is considered that a mutation consists in the change of a pangen from one condition to another, and sometimes in the formation of new pangens. These conceptions are largely in harmony with the cytological facts.

Aside from these theoretical matters, one of the most important contributions of the work is to show by many instances that new and constant races frequently result from crossing—races the characters of which, moreover, are not Mendelian recombinations, but in which many of the characters have been modified. The most prominent achievements of the book appear to be in showing (1) that mutation as a process is not to be confounded with the mere recombinations of unit-characters, and (2) that various types of hereditary behaviour exist, only occasional characters showing the Mendelian type of segregation.

R. R. G.

THE NEW PSYCHOLOGY.

(1) *Man and His Future.* Part ii., The Anglo-Saxon: His Part and His Place. By Lieut. Col. William Sedgwick. Pp. 217. (London: Francis Griffiths, 1913.) Price 6*s.* net.

(2) *The Fate of Empires: being an Inquiry into the Stability of Civilisation.* By Dr. A. J. Hubbard. Pp. xx + 220. (London: Longmans, Green and Co., 1913.) Price 6*s.* 6*d.* net.

(3) *The Science of Human Behaviour: Biological and Psychological Foundations.* By Dr. Maurice Parmelee. Pp. xvii + 443. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) Price 8*s.* 6*d.* net.

(4) *Die Neue Tierpsychologie.* By Georges Bohn. Autorisierte deutsche Ubersetzung von Dr. Rose Thesing. Pp. viii + 183. (Leipzig: Veit and Co., 1912.) Price 3 marks.

IT may be stated as a truism that every new development of science modifies opinion as to the meaning and destiny of man himself. Well-intentioned sentimentalists, like the late Henry Drummond, try to "reconcile" science and religion by a metaphorical interpretation of both. Such attempts illustrate the popular instinct for unification, which is itself a part of religion and the kernel of metaphysical philosophy. Such a volume as Lieut.-Colonel Sedgwick's "Man and his Future" (1) is thus a sociological phenomenon, illustrating the vitality and variation of popular philosophy. The Anglo-Saxon, he says, has instituted the Age of Machines and Instruments; by means of these he is beginning to separate the component bricks of the universe (Clerk Maxwell's metaphor)—the atoms. Man is therefore on the eve of a great development, which is the integration of the whole universe (Herbert Spencer's metaphor)—whatever that may mean—by the employment of the forces of attraction against those of repulsion. The former and the men using them are, says this author, guided by Christ; the latter by Satan. A pre-occupation with the periodic theory of Mendeléeff and his school is the basis of these lucubrations.

On a higher but equally metaphorical plane is Dr. Hubbard's "The Fate of Empires" (2). This work, both in substance and in style, is an echo of Kidd's "Social Evolution." The author is struck by the simultaneity in civilisation of socialistic phenomena and a declining birthrate. First-hand acquaintance with the intensive population and the family instinct (*hiao*) of China has inspired an investigation into the causes of the fall of Greece and Rome. The cure of the fate of empires is religious motive, which, says our author, is the final social impulse, superseding reason, as reason superseded instinct. But, as has been done before, he confuses "reason" with the acquisitive instinct.

The scientific student of man and his meaning, fate, or place in the universe may be thoroughly recommended to Dr. Parmelee's study of his behaviour, or, rather, introduction to the subject (3). The work of men like Jennings, Loeb, and Bohn has revolutionised animal psychology, and is now influencing human. "Animal Behaviour" has inspired "Human Behaviour." Dr. Parmelee gives a clear and up-to-date account of the facts of tropism, sense of difference (*Unterschiedsempfindlichkeit* of Loeb, *sensibilité différentielle* of Georges Bohn), "instinct," and the associational intelligence. His judgment is discriminating, and the general student could not have a better introduction to comparative psychology in its application to man and society. His anthropological discussion is confined to the impulses behind the social "instinct." Preceding this is a good account of animal "societies."

The scope of the book may be illustrated by the following:—

"In all study of behaviour it is necessary to begin with the structural form upon which is based the action-system which determines the behaviour. . . . Then were studied the direct reactions of the lower animals to external forces. But when the nervous system developed, these reactions became more or less indirect, so that we find new types of behaviour appearing. The fundamental type of behaviour determined by the nervous system is the reflex action. These actions become in course of time combined into complex forms, which are usually called instincts. . . . There has been a tendency on the part of many writers . . . to regard instinct as a form of behaviour which is not mechanically determined. The attempt has therefore been made in this book to render the conception of instinct more precise. . . . Intelligent behaviour . . . marks a new stage . . . determined by individual experience."

Consciousness and mind are then discussed, Sherrington's work being largely used.

The second of Bohn's classic handbooks to modern animal psychology has now (4), like his "La Naissance de l'Intelligence," been translated into German. "La Nouvelle Psychologie animale" was published two years ago, and the two together are already standard introductions to the modern developments of the study of mind. He prefixes as a motto the words of Giard—"L'idée de science est intimement liée à celle de mécanisme et de déterminisme." But, as students are aware, the point of view is not a temperamental or sentimental aversion from the "finalists"; it merely represents the extraordinary precision which the new methods have introduced into what was once the vaguest and most fantastic of studies. Both account and criticism are excellent, as of selection of movements, the theory of trial and error, the incompleteness of adaptation.

The analysis of some special "instincts," viz., feigning death, return to rest, the search for food, mimicry, social "instincts," is a valuable part of the book. Equally valuable and especially interesting is the discussion of methods, such as the *Dressurmethode* (the training of animals), *Vexierkasten* (puzzle boxes), labyrinths, &c. One of the newest is that of Pawlow, to which is devoted the largest section. The chief work of the great Russian physiologists, Pawlow, Zéliony, and Orbéli, is based on their remarkable tests of psychical saliva-reaction, as yet not so well known in England as they deserve.

A. E. Crawley.

POPULAR BOTANICAL PUBLICATIONS.

(1) *Plant Life.* By Prof. J. Bretland Farmer. Pp. viii+255. (London: Williams and Norgate, n. d.) Price 1s. net.

(2) *Toadstools and Mushrooms of the Countryside.* By Edward Step. Pp. xvi+143+136 plates. (London: Hutchinson and Co., 1913.) Price 5s. net.

(3) *Wild Flower Preservation.* By May Coley. Pp. 181+29 plates. (London: T. Fisher Unwin, n. d.) Price 3s. 6d. net.

(1) IN this welcome addition to the well-known "Home University Library," Prof. Farmer has produced a work which, owing to its freshness of treatment of various problems of plant life, will be useful to students of botany, besides fulfilling admirably the object of the series of which it forms part—namely, the popularising of knowledge and the creation as well as the satisfaction of a desire among general readers for really authoritative and accurate, though simplified, treatises on various branches of knowledge, published at a popular price. The keynote of the book is the presentation of the main features of plant form from the viewpoint of function, and the author has touched upon various matters not usually discussed in works of this limited size, instead of simply going over ground already covered in numerous books of this scope.

Of the twenty chapters into which the book is divided, the first five deal mainly with the lower green algæ, and it would be difficult to devise a better starting-point than that afforded by these simple types, which serve as an admirable introduction to the study of the fundamental facts of plant life. Following an account of the work of the green leaf and the root, in which emphasis is rightly laid on the manner in which the whole conformation of the plant is dominated by the leaf or other equivalent green surface, there is an admirable chapter on mechanical problems and their solution. A large section is then devoted to the adaptations shown by climbing and aquatic plants and epiphytes, as well as the relations of plants in general to water supply. Subsequent chapters deal with fungi, fungal and flowering-plant parasites, various cases of symbiosis, vegetative and sexual reproduction, and finally the nucleus and the process of fertilisation. An appendix gives a short but well-chosen bibliography.

(2) Mr. Step's handy guide to the larger fungi is a marvel of cheapness, the excellent photographic illustrations being alone well worth the price of the book. The cap-fungi lend themselves so well to "popular" treatment, owing to the absence of technical terminology in their description, that it is perhaps a matter for surprise that a work of this kind has not been published earlier, and there can be little doubt that the author's reputation for the production of readable accounts of our native plants, illustrated by skilful photographs, will ensure for the present work a wide sale. Mr. Step has purposely refrained from dealing with the classification of the plants dealt with, but the book would certainly have been rendered more useful if he had supplied a simplified key for enabling the beginner to identify the species described and depicted in the book.

(3) One is inclined to look askance at a book the main object of the author of which appears to be the advocacy of extensive collecting and drying of wild flowers, root and all, rather than the other aspect of "wild flower preservation" concerning which much has been written recently by those who deplore the raids made upon our native flora by collectors of various kinds. To be quite fair, it must be admitted that the author does deprecate greedy and destructive gathering, and that her book is written in a pleasant and enthusiastic style which to a large extent disarms criticism; while her suggestions on the keeping of records in a note-book, &c., are likely to prove

useful to young botanists. In fact, this work would be all that is desirable for the attraction of new adherents to nature study if the author were either to omit entirely the portions dealing with the preparation of herbarium specimens, or to exhort the reader to keep on the safe side of "wild flower preservation" by refraining from digging up any except the very commonest plants; after all, the roots of plants are so uniform in morphology that the collector, young or old, would lose little by letting them remain in the soil and contenting himself with taking samples from the upper portions of the plants—if it is considered necessary to make a herbarium collection at all.

F. C.

OUR BOOKSHELF.

A Medley of Weather Lore. Collected by M. E. S. Wright. Pp. 144. (Bournemouth: H. G. Commin, 1913.) Price 2*s.* 6*d.* net.

"Of the making of many books there is no end," and the natural result is that some books remind us that better books have already been written which tell us what the new ones have to tell. There is scarcely a weather proverb in the present book which is not given in Inward's "Weather Lore," a book with which the author claims no acquaintance; there are a number of beautiful quotations which make one long for summer when summer is not here; and there are, in addition, a few sayings, such as "If boys be beaten with an elder stick it hinders their growth," whose association with the weather is remote Perhaps they are essential to a "Medley."

And yet the book has a charm; I saw it picked up and read with the greatest pleasure by a visitor to a meteorological library; I myself have renewed my acquaintance with old friends scattered through its pages, and wondered at the generations of experience which went to the production of such sayings as:—

Maayres taails an' mackerel sky,
Not long wet nor not long dry.

or,

In the middle ot May comes the tail of the winter.

Some of the sayings quoted are frankly untrue, and ought, I suppose, to be omitted on that account. Such are:—

There is never a Saturday in the year
But what the sun it doth appear.

or,

No weather is ill
If the wind be still.

but perhaps this latter is intended for use by seasick folk.

Possibly the appearance of the book may stimulate some meteorologist to select the better-known and representative sayings from the large numbers available, and to bring the light of modern physical and meteorological knowledge to bear upon them. A short article of this character was published two years ago by Prof. Humphreys in the *Popular Science Monthly*; it might with advantage be consulted by anyone interested in the subject.

E. G.

Weltsprache und Wissenschaft. By Prof. L. Couturat, Prof. O. Jespersen, Prof. R. Lorenz, Prof. W. Ostwald, and Prof. L. von Pfaundler. Zweite Auflage. Pp. vi+154. (Jena: Gustav Fischer, 1913.) Price 2 marks.

THE displacement of Latin by the national languages in scientific publications since medieval times is one of the few phenomena at variance with the general tendency to internationalise the means of intellectual communication, such as we find it in musical and algebraic notation, the Morse alphabet, the metric system, and the flag-signalling code. The reaction against this separatist tendency in language is found in the three main attempts to devise an international auxiliary language, viz. Schleyer's "Volapük" (1879), Zamenhof's "Esperanto" (1887), and the "Ido" of the International Delegation of Academies (1908).

The present work is a powerful plea for the adoption of the last, and it must be acknowledged that a very strong case is made out in favour of this improved form of Esperanto, in which most of the beauty and flexibility of Zamenhof's masterpiece is retained, and the changes are directed towards facilitating the printing and improving the logical structure of the auxiliary language. It is interesting to note that biological and mathematical vocabularies for Ido, English, German, French, and Italian are already published, and that some twenty journals are devoted to the new international idiom.

Physics: an Elementary Text-book for University Classes. By Dr. C. G. Knott. Pp. vi+370. (London: W. and R. Chambers, Ltd., 1913.) Price 7*s.* 6*d.*

THE first edition of Dr. Knott's text-book of physics was reviewed in the issue of NATURE for April 15, 1897 (vol. lv., p. 557). Since its first appearance radium has been discovered, and the demand for a new edition of his work has provided Dr. Knott with the opportunity to add a new chapter on the electron theory and radioactivity, to indicate recent advances in other lines of physical research, and to amplify and revise the book as a whole.

How to Enter the Civil Service: a Practical Guide to State Employment for Men and Women. By Ernest A. Carr. New edition. (London: Alexander Moring, Ltd., 1913.) Price 2*s.* 6*d.* net.

THIS useful compendium provides the essential facts as to the conditions of entry to the Civil Service, the various appointments, the subjects of examination, and the prospects of persons entering the service of the State. Specimen examination papers and hints to students are provided also. The present edition will be found to be fully up-to-date and to provide an account of present conditions.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Synthesis by Means of Ferments.

THE short article on the synthesis of glucosides by means of ferments in NATURE for November 6 (p. 304) contains the statement, "hitherto it has not been proved that enzymes have anything but an analytical action." "Prof. Bourquelot . . . has, however, obtained results which justify the conclusion that the decomposing action continues up to a certain point only, and that at this point synthetic action begins." Prof. Bourquelot's discovery is by no means new, because in 1898 Dr. Croft Hill, in a paper on reversible zymolysis in the Transactions of the Chemical Society for 1898 (vol. lxxiii., part 2, p. 634) not only showed that the products of fermentation arrested the action of the enzyme which caused it, but also that if these products reached a certain concentration, the enzyme instead of producing further hydrolysis began to reverse its action into a synthetic one, and built up instead of breaking down. These experiments were further extended and described in the Transactions of the Chemical Society for 1903 (vol. lxxxiii., part 1, p. 578), where he also gives an account of experiments made by other authors, and concludes (p. 597) with the words: "These observations, together with my own more recent results, make it increasingly more probable that the view I put forward in 1898 is a correct one, namely that all ferment actions are reversible." LAUDER BRUNTON.

10 Stratford Place, Cavendish Square.

Amœbocytes in Calcareous Sponges.

I THINK there can be little doubt that the Amœbæ referred to by Mr. Orton in NATURE of November 27 are not independent organisms, but constituents of the sponge from which he obtained them. I have been working for some time past at the problem of the origin of the germ cells in the common *Grantia compressa*, and have often found the flagellate chambers of the sponge crowded with amœboid cells, which can sometimes be seen actually squeezing themselves through the layer of collared cells. According to my observations, these amœbocytes are immature germ cells—oogonia and spermatogonia—and they can often be seen undergoing mitosis in the chambers. A similar phenomena has been described in Sycon by Jörgensen. Possibly the amœboid cells squeezed out from the gastral cavity of Sycon by Mr. Orton were either of the same nature or else metamorphosed collared cells. The latter are very readily detached from their proper position in the sponge, and may then put out pseudopodia and come to resemble Amœbæ, as has long been known.

As it is likely to be some time before my results can be ready for publication, I may take this opportunity of mentioning that I find that in *Grantia compressa* the amœboid germ cells arise in the first instance from the metamorphosis of collared cells, and not, as is sometimes stated, from primitive amœbocytes, or archæocytes.

I spent a fortnight in April, 1912, at the Plymouth Laboratory in the investigation of these problems, and in collecting and preserving the material necessary for continuing the work. I have now an almost complete series of stages of the oogenesis, the most interesting feature of which is perhaps the feeding of the growing ova by nurse cells, the latter being phagocytes which capture other cells and stuff them into the ova. I have also a number of stages of spermatogenesis. The sponge (*G. compressa*) is hermaphrodite, and sperm morulæ are to be found (in April), enclosed in cover-cells, wedged in between the collared cells in the lining of the flagellate chambers. Haeckel described and figured the sperm morulæ in this situation in various calcareous sponges so far back as 1872, but his results do not seem to have been generally accepted.

The character of the nucleus, to which Mr. Orton refers as a means of distinguishing his supposed Amœbæ from sponge cells, varies greatly according to circumstances, and cannot be regarded as conclusive.

ARTHUR DENDY.

University of London, King's College, November 27.

Intra-atomic Charge.

THAT the intra-atomic charge of an element is determined by its place in the periodic table rather than by its atomic weight, as concluded by A. van der Broek (NATURE, November 27, p. 372), is strongly supported by the recent generalisation as to the radio-elements and the periodic law. The successive expulsion of one α and two β particles in three radio-active changes in any order brings the intra-atomic charge of the element back to its initial value, and the element back to its original place in the table, though its atomic mass is reduced by four units. We have recently obtained something like a direct proof of van der Broek's view that the intra-atomic charge of the nucleus of an atom is not a purely positive charge, as on Rutherford's tentative theory, but is the difference between a positive and a smaller negative charge.

Fajans, in his paper on the periodic law generalisation (*Physikal. Zeitsch.*, 1913, vol. xiv., p. 131), directed attention to the fact that the changes of chemical nature consequent upon the expulsion of α and β particles are precisely of the same kind as in ordinary electrochemical changes of valency. He drew from this the conclusion that radio-active changes must occur in the same region of atomic structure as ordinary chemical changes, rather than with a distinct inner region of structure, or "nucleus," as hitherto supposed. In my paper on the same generalisation, published immediately after that of Fajans (*Chem. News*, February 28), I laid stress on the absolute identity of chemical properties of different elements occupying the same place in the periodic table.

A simple deduction from this view supplied me with a means of testing the correctness of Fajans's conclusion that radio-changes and chemical changes are concerned with the same region of atomic structure. On my view his conclusion would involve nothing else than that, for example, uranium in its tetravalent uranous compounds must be chemically identical with and non-separable from thorium compounds. For uranium X, formed from uranium I by expulsion of an α particle, is chemically identical with thorium, as also is ionium formed in the same way from uranium II. Uranium X loses two β particles and passes back into uranium II, chemically identical with uranium. Uranous salts also lose two electrons and pass into the more common hexavalent uranyl compounds. If these electrons come from the same region of the atom uranous salts should be chemically non-separable from thorium salts. But they are not.

There is a strong resemblance in chemical character between uranous and thorium salts, and I asked Mr. Fleck to examine whether they could be separated by chemical methods when mixed, the uranium being kept unchanged throughout in the uranous or tetravalent condition. Mr. Fleck will publish the experiments separately, and I am indebted to him for the result that the two classes of compounds can readily be separated by fractionation methods.

This, I think, amounts to a proof that the electrons expelled as β rays come from a nucleus not capable of supplying electrons to or withdrawing them from the ring, though this ring is capable of gaining or losing electrons from the exterior during ordinary electrochemical changes of valency.

I regard van der Broek's view, that the number representing the net positive charge of the nucleus is the number of the place which the element occupies in the periodic table when all the possible places from hydrogen to uranium are arranged in sequence, as practically proved so far as the relative value of the charge for the members of the end of the sequence, from thallium to uranium, is concerned. We are left uncertain as to the absolute value of the charge, because of the doubt regarding the exact number of rare-earth elements that exist. If we assume that all of these are known, the value for the positive charge of the nucleus of the uranium atom is about 90. Whereas if we make the more doubtful assumption that the periodic table runs regularly, as regards numbers of places, through the rare-earth group, and that between barium and radium, for example, two complete long periods exist, the number is 96. In either case it is appreciably less than 120, the number were the charge equal to one-half the atomic weight, as it would be if the nucleus were made out of α particles only. Six nuclear electrons are known to exist in the uranium atom, which expels in its changes six β rays. Were the nucleus made up of α particles there must be thirty or twenty-four respectively nuclear electrons, compared with ninety-six or 102 respectively in the ring. If, as has been suggested, hydrogen is a second component of atomic structure, there must be more than this. But there can be no doubt that there must be some, and that the central charge of the atom on Rutherford's theory cannot be a pure positive charge, but must contain electrons, as van der Broek concludes.

So far as I personally am concerned, this has resulted in a great clarification of my ideas, and it may be helpful to others, though no doubt there is little originality in it. The same algebraic sum of the positive and negative charges in the nucleus, when the arithmetical sum is different, gives what I call "isotopes" or "isotopic elements," because they occupy the same place in the periodic table. They are chemically identical, and save only as regards the relatively few physical properties which depend upon atomic mass directly, physically identical also. Unit changes of this nuclear charge, so reckoned algebraically, give the successive places in the periodic table. For any one "place," or any one nuclear charge, more than one number of electrons in the outer-ring system may exist, and in such a case the element exhibits variable valency. But such changes of number, or of valency, concern only the ring and its external environment. There is no in- and out-going of electrons between ring and nucleus.

FREDERICK SODDY.

Physical Chemistry Laboratory,
University of Glasgow.

Philosophy of Vitalism.

IN NATURE of November 6 Prof. E. W. MacBride has made some critical remarks with regard to my proof of vitalism as discussed in the first of the four lectures which I had the honour to deliver before the University of London in October. Will you kindly permit me to explain in how far I feel unable to accept Prof. MacBride's criticism?

I fully agree with him that vitalism has nothing to do with the progress of zoology as a pure science in the narrower sense of the word. As I have said in my "Biologie als selbständige Grundwissenschaft" (second edition, 1911, p. 24): "The problem of the *method* of biology remains unaffected by the controversies between vitalism and mechanism."

But I cannot accept Prof. MacBride's opinion about the theoretical, or, if he would choose to say so, philosophical importance of the concept of *entelechy*. He believes "that at the best the conception of entelechy is of quite limited application." He speaks of the fact that, under special experimental conditions a lizard may regenerate two tails instead of one, that the egg of Ascidians (he might have added that of Ctenophores, a case well known to me from my own experiments) possesses a very limited faculty of regulation, &c. But, has it not been for the very reason of the *fact* that there are "limits of regulability" that I have invented a rather complicated theory of the possible relations between entelechy and matter (see my Gifford lectures, vol. ii., p. 178ff., and the second of my London lectures)? Thus it appears, so I hope, that I have never neglected the limited character of regulability and the dependence of the effects of what I call entelechy on matter. Entelechy is *not* omnipotent. But it seems to me that limitation does not mean non-existence.

For, on the other hand, there are very many cases (development of isolated blastomeres or parts of the blastula of Echinoderms, &c., into small but complete organisms, restitution of Clavellina, Tubularia, &c.) where entelechy acts, so to say, in quite a pure manner. And it is on *these* cases, of course, that the concept of entelechy was founded in the first place. Would not also a physicist whose aim it is to study the laws of the reflection of light, prefer for his experiments such materials, which do well reflect rays and do not show the phenomenon of absorption, or only in a very small degree? Logically, in fact, one single case of what I call harmonious equipotentiality would suffice to establish vitalism. But there are many cases.

Prof. MacBride does not attack my analysis of harmonious equipotentiality as such. And, in fact, the theory of organ-forming substances, which he advocates, cannot account at all for the differentiation of "harmonious-equipotential systems," though we might accept it, perhaps, if there were *only* eggs, such as those of Ascidians, Ctenophores, &c. Organ-forming substances have to be ordered or arranged during ontogeny; now this could only happen on the basis of a *machine*, if we believe that it happens on a physico-chemical foundation altogether. But just a "machine" is excluded by the phenomenon of harmonious equipotentiality.

Thus I believe that, even if we concede to Prof. MacBride that the conception of entelechy is "of quite limited application," we are entitled to say: In the theory of the harmonious-equipotential system the concept of entelechy *must necessarily be applied*.

HANS DRIESCH.

Heidelberg, November 12.

THE courteous reply of Prof. Driesch to my letter on vitalism which was published in NATURE of November 6 calls for only a few remarks from me. If Prof. Driesch and I were discussing questions of epistemology or of consciousness, questions in which as an amateur I have taken an interest for many years, it is possible that our points of view might not be so far apart; it would certainly be possible to arrange a *modus vivendi* between them. But for me the value of a conception in zoology is its fruitfulness in connecting facts and in leading to the discovery of new facts; and my objection to the conception of *entelechy* is not that it is idealistic, but that it is barren.

Prof. Driesch now candidly admits that if he had only eggs like those of Ascidians and Ctenophores to deal with the theory of organ-forming substances might suffice, but that in order to account for what he calls a "harmonious-equipotential system," and for what I call an undifferentiated type of egg (or bud) an entelechy must be postulated. Now if the inversion of the two-celled stage in the development of the frog's egg will produce such a rearrangement of materials that *two* embryos and not *one* result, is it not just possible that the closing up of a fragment of a blastula of Echinus may lead, under the stress of forces which we may picture to ourselves as surface tension, &c., to such a rearrangement of materials as may issue in a perfect larva of reduced size instead of in a half larva? That organ-forming substances limited to special regions do exist in the later embryo of Echinus Prof. Driesch has himself shown in one of the most exquisite of his earlier researches. At any rate, if we adopt this hypothesis we shall be urged on to further researches as to the conditions of this rearrangement, whereas if we adopt the theory of an entelechy about the ideas or methods of working of which we know nothing, all future research is stopped.

The eggs of Asteroids and Echinoids show great resemblances in their earlier stages of development coupled with subsequent divergences. On Prof. Driesch's theory these divergences are due to differences in the indwelling types of entelechy, and no further explanation is possible. But when Prof. Driesch's friend and colleague, Prof. Herbst, shows that an Asteroid egg can be made to develop into something like the Echinoid blastula by immersing it in a solution of KCNS, then we are led to speculate as to the nature and origin of the chemical differences between these two types of egg, which cause the differences in their development.

Prof. Driesch refers to the case of the physicist who selects "pure material" for his experiments. I may reply by citing the case of the physiologist who in investigating nervous phenomena, chooses clearly differentiated nerve for his material, and would never dream of beginning by examining the phenomena of conduction in Amœba. I contend that eggs with organ-forming substances definitely localised are far "purer material" for the analysis of the forces of development than the undifferentiated eggs of Echinus. E. W. MACBRIDE.

Imperial College of Science, November 15.

The Kathode Spectrum of Helium.

A NUMBER of articles have recently appeared in scientific journals dealing with a spectrum frequently associated with the spectrum of helium and by some attributed to impurities in the helium. A few words relative to this interesting and very beautiful spectrum will, I think, clear up the question of the source of the spectrum.

If a helium tube be prepared with *disc* electrodes, carefully freed from impurities, and operated on a transformer or continuous current (*not* on an induction-coil discharge), the region about the kathode will be filled with a bright pink glow. The spectrum of this kathode glow is the spectrum in question. It is simply the kathode spectrum of pure helium. If care be taken to avoid stray light from the anode column it may be obtained quite free from the ordinary (anode) spectrum of helium. When the disruptive discharge from an induction coil is used to excite the tube or the tube is viewed end on through a cylindrical electrode, the two spectra appear mixed in various proportions.

During the writer's several years of work at the Bureau of Standards on the helium tube as a primary light standard, scores of helium tubes were prepared and operated as above described. It was noted that the kathode glow was pale and greyish until the last traces of impurities has disappeared, when it turned to a bright pink. In fact, the appearance of the kathode glow is an infallible criterion for the purity of the helium, a spectroscope being unnecessary. The kathode spectrum of helium, viewed with a large, high intensity spectroscope, will be recalled by many who have visited the bureau during the last four years. Goldstein's spectrogram reproduced in the *Physikalische Zeitschrift*, July 15, 1913, is a very good one considering the photographic difficulties.

It is well known that most gases exhibit two and a few three quite distinct spectra. These are the anode (primary) and kathode spectra, and the secondary spectrum obtained with a disruptive discharge. Nitrogen is a familiar example of a gas having all three spectra. Helium is one of the few gases and vapours the primary and secondary spectra of which are alike, but the anode and kathode spectra of which are quite different. P. G. NUTTING.

Rochester, N.Y., November 7.

Observation of the Separation of Spectral Lines by an Electric Field.

THE effect of the electric field upon spectral lines is a problem which has caused much discussion without being solved by experiment until to-day. Applying a very intense electric field in an incandescent gas, and using suitable optical arrangements, I succeeded in separating several spectral lines into components. These are polarised rectilinearly in relation to the axis of the electric field in the transversal effect (radius of vision normal to the electric field). With the dispersion used, the hydrogen lines $H\beta$ and $H\gamma$ are resolved by the electric field into five components. The three located in the middle are in electric oscillation normally to the electric field, the two outer ones parallel to it. My first paper on the new phenomenon will soon be published in the *Berichte der Berliner Akademie der Wissenschaften*.

J. STARK.

Aachen, Technischen Hochschule, November 21.

Phosphorescence of Mercury Vapour.

LAST July I published in the Proceedings of the Royal Society an account of a persistent fluorescence of mercury vapour produced by excitation of "2536" light, obtained from a quartz-mercury arc lamp. I have recently placed the fluorescent vapour in a strong magnetic field, and find that when the mercury lamp is cooled and consequently the "2536" line is sharp, the magnetic field increases the intensity of the fluorescence several times. If the lamp is allowed to warm up so that the "2536" line becomes broadened and reversed, the opposite effect is obtained, *i.e.* the phosphorescence decreases in intensity with the field. In this latter case the field strength that produces the greatest diminution in intensity increases with the temperature of the quartz-mercury lamp. The ordinary fluorescence produced by the light from the cadmium spark is not affected by the magnetic field. I am at present working with the idea of obtaining a satisfactory explanation of the persistent fluorescence and the various phenomena connected with it.

F. S. PHILLIPS.

Imperial College of Science and Technology, November 24.

A Remarkable Meteor on November 24.

I was much interested in seeing Dr. Rambaut's letter describing a brilliant meteor seen at Oxford on the evening of November 24. I was travelling along the London to Oxford road at the time, and when passing through Stokenchurch (seventeen miles from Oxford) was suddenly aware of a pale green light of sufficient intensity to be quite noticeable even when looking down at the road. On looking up I saw the meteor just as it disappeared. It presented the appearance of a luminous green ball of about one-quarter the sun's diameter, though this can only be regarded as quite an approximate estimate. My first impression was that the phenomenon was an unusual type of meteor, but on account of the brilliant green colour I immediately afterwards came to the conclusion that it must have been a rocket, and therefore did not unfortunately note the exact time or careful particulars as to the position. I should estimate that the meteor lay about N.N.E. when I saw it, but that the altitude was somewhat greater than the 17° given by Dr. Rambaut. The agreement in time and place was, however, sufficiently close to leave no doubt that it must have been the same phenomenon. The intensity of the illumination may be judged from the fact that the light was quite noticeable to one not looking up towards the sky at the time.

J. S. Dines.

Meteorological Office, South Farnborough Branch, December 1.

I regret to have to have to point out a mistake in my letter printed in Nature for November 27 (p. 372). The altitude of the meteor should have been given as 27°, not 17°, as there stated.

As the error appears in my copy, I fear I must bear all blame for it.

Arthur A. Rambaut.

Radcliffe Observatory, Oxford, December 1.

THE BRITISH RADIUM STANDARD.

An account of the preparation and testing of an international radium standard was given in the issue of this journal for April 4, 1912 (vol. lxxxix., p. 115). It will be remembered that a radium standard containing 21·99 milligrams of pure radium chloride was prepared by Mme. Curie for the International Committee. At a meeting in Paris the standard of Mme. Curie was compared with another independent standard prepared in Vienna by Professor Hönigschmidt, and the two were found to agree well within the limits of accuracy of measurements by the γ ray method. The preparation of Mme. Curie was accepted by the Committee as the International Standard, and was deposited in the Bureau du Poids et Mesures at Sèvres, near Paris. At the same time it was arranged that the Vienna preparation should be retained in Vienna as a secondary standard. Arrangements were made to allow Governments to obtain duplicates of the international standard. For this purpose the Austrian Government generously offered to provide the radium required at a considerable reduction in price. It was arranged that duplicate standards should be prepared and tested in Vienna in terms of their secondary standard, and then sent on to Paris to be tested again in terms of the international standard. In all six duplicate standards have now been prepared for different Governments, and the independent standardisations of the radium content in Vienna and Paris has been found to be in remarkably good agreement. The comparisons of the quantities of radium is made by means of the penetrating γ rays, and it is a striking testimony to the accuracy of this method that the independent measurements have agreed so closely, although widely differing experimental arrangements have been employed in the two places.

It will be remembered that Dr. Beilby, F.R.S., very generously defrayed to Mme. Curie the cost of the radium forming the international standard, and thus relieved the International Committee of the necessity of collecting special funds for this purpose. Immediately after the fixing of the international standard, arrangements were made in this country to obtain a duplicate standard to be placed in charge of the National Physical Laboratory at Teddington. Dr. Beilby again stepped in in a very generous manner and agreed to defray the expense of acquiring the British radium standard, which was delivered to the National Physical Laboratory a few months ago. The British radium standard does not differ much in radium content from the international standard, containing about 20 milligrams of pure radium chloride.

A circular has now been issued by the National Physical Laboratory, stating that they are prepared to standardise preparations of radium and mesothorium in terms of the international standard, and a detailed list of testing charges has been issued. In the beginning, the Laboratory has very wisely confined itself to undertaking the standardisation of strong preparations of radium and mesothorium only. The comparison with the British standard will be made by γ ray methods. Tests on radio-active minerals, radio-active waters and other materials of weak activity, will not be undertaken at the moment, though, no doubt, arrangements will be made as the new radio-active department progresses to undertake some work of this character in the future. The Laboratory sends out a certificate that the active material under examination shows a γ ray activity equivalent to a certain weight of metallic radium, but no guarantee is given of whether the activity is due to radium itself, for it is well known that it is not easy to distinguish without special tests between preparations of radium and mesothorium. Preparations of the latter are standardised by expressing their γ ray activity at the time of testing in terms of a definite weight of metallic radium in radio-active equilibrium. Both the Reichsanstalt and the National Physical Laboratory express the activity of their preparations in terms of metallic radium, and not in terms of bromide or chloride. This appears to me a very wise step, for it is obviously more definite and scientific to express the results in this form. It is also very desirable that all radium should be bought and sold in terms of metallic radium, thus avoiding the uncertainty that sometimes arises as to whether the preparation is being sold as anhydrous radium bromide or radium bromide with its water of crystallisation.

The radio-active department in the Reichsanstalt has now been in operation for more than a year, under the charge of Dr. Geiger, whose radio-active researches in the University of Manchester are well known. The creation of this department has been found to fill a much-needed want, and it is not too much to say that practically all the radium and mesothorium that is bought and sold in Germany requires to-day the certificate of the Reichsanstalt. The number of standardisations required have increased very rapidly, and several assistants have been added to the department in charge of this work alone. There can be no doubt that the institution of a radio-active department in the National Physical Laboratory will prove of great service to this country, not only for scientific, but also for commercial purposes. It is well known that the buying and selling of radium in the past has been a very uncertain and risky procedure, for in most cases the radium content has not been expressed in terms of any authorised standard. This difficulty is removed by the present arrangement, and we should strongly recommend that those who wish to buy radium or mesothorium, whether for scientific or for medical purposes, should do so conditional on the certificate of standardisation from the National Physical Laboratory.

It is understood that the work of testing and standardisation will be under the supervision of Dr. W. G. C. Kaye, of the National Physical Laboratory, whose pioneer work on the production and distribution of X-rays is well known to all physicists. The ability and skill in measurements which he has shown both in his work in the Cavendish Laboratory and in the National Physical Laboratory, afford the best of guarantees that the work of the new department will be carried out in a thoroughly satisfactory manner.

E. Rutherford.

SIR ROBERT BALL, F.R.S.

Robert Stawell Ball was born in Dublin on July 1, 1840, the eldest son of Dr. Robert Ball, director of the Natural History Museum in the University of Dublin and secretary of the Queen's University in Ireland. After attending school at Abbott's Grange, Chester, he entered Trinity College, Dublin, in 1857. He became a mathematical scholar in 1860, Lloyd exhibitioner the same year, and graduated in 1861 as gold medallist in mathematics, first gold medallist in experimental and natural sciences and University student in mathematics. Towards the end of 1865 he went to Parsonstown as tutor to the three younger sons of the third Earl of Rosse and observer with the great six-foot and three-foot telescopes. When Ball began to use the six-foot reflector in February, 1866, nearly all the larger and more interesting nebulæ had been frequently observed and carefully drawn, and he therefore chiefly devoted himself to work with the micrometer, a difficult task, since the telescope at that time had not yet been provided with a clock motion. He was the first observer with the instrument who corrected the measured position angles for the error due to the telescope not being equatorially mounted, but supported at the lower end on a universal joint. His observations were included in the "Observations of Nebulæ, 1848–78," published by the late Lord Rosse in 1879–80.

In the autumn of 1867, shortly before the death of the maker of the great telescope, Ball was appointed professor of applied mathematics and mechanism at the newly established Royal College of Science for Ireland, in Dublin. He was singularly well fitted for this post, as he was not only an excellent mathematician and had the power of elucidating even abstruse subjects in simple and clear language, but also possessed great skill in experimental work. In addition to his regular class work, he also sometimes gave evening lectures on mechanics in a more elementary form, and in 1871 he published his first popular book, "Experimental Mechanics," which was very well received and showed his great aptitude both as a popular lecturer and as a writer. It led to his being much sought after as a lecturer; and as lectures on mechanics required a large amount of apparatus, he preferred to lecture on popular astronomy, and by degrees he became the most successful lecturer on this subject, not only in this country, but in after years also in America.

In January, 1870, Ball read a paper before the Royal Irish Academy on the small oscillations of a rigid body about a fixed point under the action of any forces. Out of this investigation grew the long series of memoirs which he published on the theory of screws in the course of the next thirty-four years, nearly all in the Trans. Roy. Irish Academy. This remarkable extension of theoretical dynamics, perhaps the most important contribution to that science since the introduction of couples by Poinsot, combines Poinsot's force and couple into the single conception of a wrench on a screw, the latter being regarded merely as "a directed straight line with an associated linear magnitude called the pitch." The capabilities of the theory were gradually shown to be very great, as all the results of modern algebra and geometry appear to be applicable to it. Ball published a separate book on the subject in 1876, and in 1889 Dr. Gravelius wrote a text-book in German, founded on Ball's first eight memoirs. Finally, Ball's great "Treatise on the Theory of Screws" appeared at Cambridge in 1900, but even after that date several succeeding memoirs showed that the author of the theory continued to devote his mind to its extension.

The growing fame of Ball as a mathematician and the warm interest he was known to take in astronomy naturally led the Board of Trinity College to appoint him to the Andrews professorship of astronomy in the University of Dublin, when it became vacant in 1874. Ball threw himself into his new duties at Dunsink Observatory with his usual energy, and decided to continue the investigations on the annual parallax of stars carried out by his predecessor, Brünnow, by means of micrometer observations. In addition to working on a few stars throughout the year in the usual way, he broke fresh ground by attempting to find stars with a large parallax by what he called "reconnoitring observations." He observed a great number of stars only twice, with an interval of six months, at the time of greatest parallactic displacement. In a very few cases the measures seemed to indicate that the star might be within a measurable distance from us, and he therefore took a regular series of observations of these stars. For two stars he found in this way parallaxes of a third of a second and half a second, which, however, were not subsequently confirmed, and the rapid rise of astronomical photography has led to the complete abandonment of visual observations in work on annual parallax. But Ball's experiment in search of stars with a large parallax is an interesting one all the same. For three or four years he devoted his whole time to this work, which he arranged and carried out in the most businesslike and methodical manner, often observing till 2 or 3 o'clock in the morning, and the results were published in Parts III. and V. of the Dunsink Observations, the latter of which appeared in 1884. After that time he seems to have done very little observing, probably on account of renewed trouble with one of his eyes, which had been accidentally injured in his youth, and later (in 1897) had to be removed.

In 1884 Ball was appointed scientific adviser to the Commissioners of Irish Lights, and in 1886 he was knighted by the Lord Lieutenant of Ireland. In February, 1892, he was elected Lowndean professor of astronomy and geometry and director of the Observatory at Cambridge, leaving Dunsink to take up the appointment in the following autumn. At Cambridge he continued as previously to divide his time between his official duties, his mathematical researches, and his activity as a popular lecturer and writer of popular astronomical books and articles. He was president of the Royal Astronomical Society in 1897–99. In 1908 he published his last book, "A Treatise on Spherical Astronomy," more intended for the use of college students than for practical astronomers, but written in his usual clear and concise style.

Sir Robert Ball died on November 25, after a long and lingering illness. His genial and hearty manner, his fund of wit and his enthusiasm for any subject which had taken hold of his mind, made him a favourite wherever he went. Anyone who has worked under him will not forget his readiness to allow his subordinates to carry out any special work in their own way and to reap therefrom whatever credit they could.

J. L. E. D.

THE ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Monday, December 1, when the report of the Council was presented and the retiring president, Sir Archibald Geikie, delivered an address. Sir William Crookes was elected president of the society, and the other officers and members of council, whose names were given in NATURE of November 13 (p. 324), were also elected.

The council reports that a critical period has been reached in the development of the work of the committee on the Catalogue of Scientific Papers. Since 1901 the sum of 21,151*l.* 15*s.* 2*d.*, mainly contributed by the late Dr. Ludwig Mond, has been expended on the preparation of the Catalogue, and with the exception of the income of the Handley Fund, now amounting to about 190*l.* a year, there are no funds available for continuing the work after the end of this year.

The whole of the tenth annual issue of the International Catalogue of Scientific Literature has been published, with the exception of the volumes of physiology and bacteriology. A meeting of the International Council will be held in 1914. At this meeting the question of continuing the Catalogue beyond the first fifteen issues will be taken into consideration.

In the course of the year the treasurer received from the executors of the late Lord Lister, securities and cash to the value of 8995*l.* 9*s.* 10*d.*, on account of a legacy left by Lord Lister to the society for its general purposes.

The financial position of the National Physical Laboratory has been a cause of anxiety to the Council. In consequence mainly of the strikes and general disturbance of trade at the beginning of 1912, the receipts for the year were less than the expenditure, and but for a considerable revival at the end of the year would have been much less. The responsibility for any deficit rests with the society; and the council, while ready to advance by all means in its power the national work of the Laboratory, considers that the society should be freed from this serious liability. It is in communication with the Treasury on the question. Much valuable work is at a standstill for want of funds.

In his presidential address, Sir Archibald Geikie referred to some of the subjects in the report presented by the council, and particularly to the national activities of the society and the inadequacy of the financial provision necessary for the carrying out of important work. He pointed out that five years ago at the request of the Home Office the council appointed a committee to investigate the physical and physiological problems presented by the disease known as glassworkers' cataract. In proposing this inquiry, the Home Office made no provision for the cost of the numerous experiments and examinations that obviously would be required, while the Royal Society has no funds at its disposal for meeting such expenditure. As only a small sum has been contributed by the Treasury, the work of the committee has been seriously delayed. The society has acquired the character of a kind of central council of science, and may legitimately claim that few scientific problems could arise affecting modern life for the solution of which the most extensive experience and the most authoritative opinion would not probably be found within its own representative ranks. The public recognition of this serviceableness has greatly increased the range of the society's activities, but there has not been a corresponding increase of financial support. Continuing, the president said:—

There is unfortunately a prevailing but mistaken impression that a society which can thus freely place its knowledge and experience at the disposal of the State must be a wealthy body. It is true that we administer every year a considerable sum of money; but almost the whole of this sum is earmarked for certain definite objects, and cannot be diverted to anything else. Even the annual Parliamentary grant of 4000*l.* for scientific investigation, which is placed in the hands of the society, is not a contribution to the society's own operations. The whole of it, except the trifling sum required for clerical assistance and necessary printing, is allocated to applicants from all parts of the country for their individual researches. . . . There is a second annual Parliamentary grant of 1000*l.* made to the Royal Society to assist in defraying the expenses of publication. But it is understood that a portion of this sum is to be set aside for the purpose of aiding the adequate publication of scientific matter through other channels and in other ways. Thus the whole of the subvention which the society receives annually from the State for its own requirements amounts to only a few hundred pounds towards the cost of its publications, together with the use of its rooms in Burlington House, where it sits rent free, but subject to expenditure for internal upkeep and repairs. . . .

When we consider the amount and value of the gratuitous service given at the request of the various public departments, it is abundantly obvious that the Government of this country is under special obligations to the Royal Society, which, were they expressed in the plain language of professional practice, would be indicated by a considerable sum of money. . . . We claim that our disinterested action deserves to be recognised by at least a generous and sympathetic attitude on the part of the Government towards our aims and objects, and a disposition to help us when our means prove inadequate to carry out the work which we have undertaken for the furtherance of the progress of science.

Sir Archibald Geikie announced that since his address was written Sir James Caird, Bart., of Dundee, so well known for his munificent benefactions to science, had sent him a cheque for 5000*l.* to be expended in yearly disbursements of about 500*l.* for the furtherance of physical research. Subjoined are summaries of the description of the work of the medallists given in the address.

The Copley medal is this year assigned to Sir Edwin Ray Lankester, in recognition of the value of his original researches in zoology and of the importance of his personal influence in stimulating the investigations of his pupils and others, which have materially extended the boundaries of our knowledge of the animal kingdom. His own work, which has been in large measure morphological, has thrown light on the mutual relations of living animals and also on the structure and affinities of long extinct organisms. His researches in the comparative embryology of the higher Mollusca and of the anatomy of the Nautilus gave him an assured place among the zoologists of his day. His early papers on the Ostracoderm fishes of the Old Red Sandstone afforded a memorable example of palæontological acumen. In addition to his original investigations, he has laid zoology under a debt of gratitude to him for his luminous general articles in some of the larger departments of the science.

The council's awards of the two Royal medals annually presented by the King have received his Majesty's approval. The medal on the physical side has been adjudged to Prof. Harold Baily Dixon, to mark the society's appreciation of the importance of his long-continued investigations of the phenomena of gaseous explosion. His important observations on the theory of combustion have shown that water-vapour acts as a carrier of oxygen during the oxidation of carbon, and undergoes a cycle of changes wherein it gives up its oxygen to carbon monoxide. From the further study of the explosion of this monoxide and oxygen, in the presence of other gases, he concluded that any substance capable of producing steam will determine the explosion. By the introduction of photography into his studies of the explosive wave he has been able to throw light on the mode of burning of carbon and its compounds.

The Royal medal on the biological side is bestowed on Prof. Ernest Henry Starling, as a mark of the society's high appreciation of the wide range of his contributions to the advancement of physiology. By his inquiry into the relation of lymph production, and the absorption of fluids from the peritoneal cavity and the cavity of the eye-ball, he showed the dependence of these processes upon the osmotic pressure of the blood and tissue fluids and the hydrostatic pressure in the blood-vessels. In his excellent studies of the mammalian heart he has greatly improved the technique. By much reducing the volume of blood needed to maintain a circulation through heart and lung, he has increased the sensibility of the preparation to variations of state, and by introducing into the circuit of the blood a readily adjusted resistance to the flow he can ascertain the effects of the obstacle upon the heart's action. He has discovered that the normal heart of the dog will consume 4 mgrm. of sugar per gram muscle per hour, but that if the animal is diabetic, the heart is incapable of consuming sugar—an observation of singular value in the light it throws upon the cause of diabetes.

The Davy medal has been awarded to Prof. Raphael Meldola, in acknowledgment of the distinction of his contributions to synthetical organic chemistry, especially in the series of aromatic compounds. He discovered the first representative of the oxazines, a group which has since been developed into one of great importance. He has contributed to the chemistry of naphthalene derivatives, and carried out extensive researches upon the azo- and diazo-compounds, with results which have an important bearing upon the question of the constitution of these compounds. He has likewise added to our knowledge of the chemistry of other groups of nitrogen-containing compounds, notably the triazines and the iminazoles. Of late years he has shown the synthetical value of compounds containing a mobile nitro-group, and has discovered a remarkable new class of quinone-ammonium derivatives.

The Sylvester medal is conferred this year on the veteran mathematician, James Whitbread Lee

Glaisher. His prominent career in mathematical science, which began at an early age, has been continued down to the present day without remission, not only in the production of original papers, but in university teaching, and in the careful editorship of most of the special mathematical journals in this country. To these journals he has constantly contributed much of his own work, such as his papers on the theory of numbers, on elliptic functions, and many other departments of pure mathematics.

In considering the bestowal of the medals this year the council has determined to award the Hughes medal to one who has spent his days in the application of scientific discovery to practical life—Alexander Graham Bell. Although he has been resident for many years on the other side of the Atlantic Ocean, we remember that he was born in Edinburgh, and was educated there and in London, so that we claim him as a fellow-countryman. His preponderating share in the invention of the telephone, now so long ago as 1876, and his practical investigations in phonetics, have laid modern civilisation under deep obligation to him, while his numerous other inventions and experiments show the fertility of his genius.

The anniversary dinner of the society was held on Monday evening at the Hôtel Métropole. Sir William Crookes presided and responded to the toast of "The Royal Society," proposed by the American Ambassador. The toast of "The Retiring President" was proposed by Sir Joseph Larmor and acknowledged by Sir Archibald Geikie. Sir Ray Lankester and Prof. Harold Dixon responded to the toast of "The Medallists," Sir David Gill proposed the toast of "The Guests," and Lord Sumner responded to it.

NOTES.

A CORRESPONDENT points out that the list of the new members of the council of the Royal Society published in NATURE of November 13 (p. 324), contains the names of ten fellows of the society who have not served on the council before, out of the total of sixteen ordinary members of the council. In the council elected in 1912, there were only five members who had not served in previous years; and the list for 1911 included eight fellows who had served before and the same number of fellows who had not done so. This year's list contains, therefore, a larger number of completely new members of the council than is usual. Ten members of the new council, and nine of the retiring council, are Cambridge men.

DR. HENRI DESLANDRES, Paris, has been elected an honorary member of the Royal Institution.

A LECTURE on the properties and uses of radium will be delivered at the Cancer Hospital (Free), Fulham Road, London, S.W., by Mr. C. E. S. Phillips, honorary physicist to the hospital, on Wednesday, December 10, at 5 p.m.

As announced already, the Physical Society's annual exhibition is to be held on Tuesday, December 16, at the Imperial College of Science, South Kensington. In the afternoon, the Hon. R. J. Strutt, F.R.S., will give a discourse on spiral electric discharges, and in the evening Mr. Louis Brennan, C.B., will show some experiments with soap films. About thirty firms of scientific instrument-makers will be exhibiting, and there will also be certain experimental demonstrations.

THE gold medal of the Apothecaries Society was awarded on November 28 to Mr. J. E. Harting, in recognition of his services in preparing and editing the catalogue of the library in Apothecaries' Hall. The society was founded in 1617, and the library, which chiefly consists of medical and botanical works, contains a number of rare old "Herbals," including a copy of Johnson's edition of "Gerarde's Herbal," published in 1633, presented by the author.

THE Board of Trade has appointed a committee to consider the causes of explosions which have occurred in connection with the use of bitumen in laying electric cables, and to report as to any steps which should be taken to prevent explosions in future from the use of bitumen or similar substances. The members of the committee are:—Sir T. Edward Thorpe, C.B., F.R.S. (chairman); Mr. R. Nelson, of the Home Office; Mr. W. Slingo, of the General Post Office; Mr. J. Swinburne, F.R.S.; and Mr. A. P. Trotter, of the Board of Trade. Mr. M. J. Collins, of the Board of Trade, will act as secretary to the committee.

AN International Dairy Congress is to be held at Berne, Switzerland, in June next. It will be the sixth congress organised and held under the auspices of the Federation Internationale de Laiterie, a body having its head office in Brussels, and a committee composed of representatives of all the leading countries in the world. The secretary of the British Dairy Farmers' Association, Mr. F. E. Hardcastle, 12 Hanover Square, W., is acting as secretary to the British Section, and will give full information to any who may be interested. The sections under which papers will be read and subjects discussed are:—I., Hygienics; II., Chemistry and Bacteriology; III., Theory of Management; and IV., Trade.

THE death is announced, in his seventy-sixth year, of the Rev. J. A. Gilfillas, who, with Mr. W. W. Cooke, made important explorations between 1880 and 1890 around the head-waters of the Mississippi. They contributed largely toward fixing Elk Lake, instead of Lake Itaska, as the chief source of that river. Mr. Gilfillas was also an expert in ethnology and in the Indian languages.

AN interesting collection of photographs from Hungary, Germany, Sweden, and New Zealand is now on view at the house of the Royal Photographic Society, 35 Russell Square, W.C., and will be open to the public on presentation of visiting card, daily from 11 a.m. to 5 p.m., until December 20. The collection includes a remarkable series of twenty-seven marine studies taken by flashlight in the Biological Marine Aquarium of Heligoland, by Mr. F. Schensky. The great technical merit of these photographs of fishes, crustacea, sea anemones, molluscs, &c., will be obvious even to the superficial observer; it is very rarely that one has the opportunity of seeing such fine work of this class. The rest of the hundred or so photographs claim attention chiefly because of their pictorial merit.

The following are among the lecture arrangements at the Royal Institution, before Easter:—Prof. H. H. Turner, a course of experimentally illustrated lectures on a voyage in space, adapted to a juvenile auditory, to begin on December 27; Prof. W. Bateson, six lectures on animals and plants under domestication; Sir John H. Biles, three lectures on modern ship-building; Mr. A. H. Smith, two lectures on landscape and natural objects in classical art; Dr. W. McDougall, two lectures on the mind of savage man; Sir Thomas H. Holland, two lectures on types and causes of earth-crust folds; Prof. C. F. Jenkin, three lectures on heat and cold; Dr. C. W. Saleeby, two lectures on the progress of eugenics; Dr. J. A. Harker, two lectures on the electric emissivity of matter; and Sir J. J. Thomson, six lectures on recent discoveries in physical science. The Friday evening meetings will commence on January 23, when Sir James Dewar will deliver a discourse on the coming-of-age of the vacuum flask. Succeeding discourses will probably be given by Mr. H. Wickham Steed, Dr. H. S. Hele Shaw, Prof. J. Norman Collie, Prof. W. A. Bone, Sir Walter R. Lawrence, Bart., the Right Hon. Lord Rayleigh, Prof. J. A. Fleming, Sir J. J. Thomson, Prof. A. Keith, and other gentlemen.

With the ordinary issue of *The Times* on Monday, December 1, appeared a special Fuel Supplement of sixty pages, in which the various aspects of the whole subject of fuel are dealt with. The appearance of this supplement to our leading daily journal and the general trend of all the articles, is evidence that the immense importance of the future supplies of fuel must be brought home to the public. Many perhaps still fail to realise the rapid depletion of our resources which is taking place daily, and the necessity for economy in production and economy in application. The first step to economy is wider knowledge, and whether for the lay reader (if there is such a person in this connection), or for the fuel expert, the series of articles is admirably adapted to give a general and sufficiently detailed account of the whole question. The various forms of fuel are described from the economic point of view: their production, distribution, properties, and the best methods of utilisation detailed. Such minor issues as smoke prevention, safety in coal mines, the scientific purchase of coal, and other complementary subjects are dealt with adequately. Nor is the future overlooked, when man will have to manufacture his fuel from materials obtainable from existing natural sources; and the claims of alcohol, which up to the present is but a very minor fuel, are discussed at some length. People more particularly interested in fuel and its commercial application will most certainly welcome the appearance of the supplement, and for others who take an intelligent interest in a subject of such general and economical importance, it furnishes a comprehensive account of the whole question.

Mr. J. Reid Moir, of Ipswich, has forwarded a typed letter and printed notices asking for careful treatment of ancient remains, to all the brickfields and other places in Suffolk where continual excavations are in progress. By this means he hopes to hear of any interesting relics which may be found, and for want of knowledge be overlooked or thrown away as being of no value.

In a letter published in Nature of November 13, Prof. D. Waterston referred to some excellent radiograms of the Piltdown mandible, and that of a chimpanzee which appeared in an October issue of *The British Journal of Dental Science*. There was an article upon the radiograms in the same issue, but Prof. Waterston was concerned only with his interpretation of the radiograms themselves. Mr. A. S. Underwood, the author of the article, writes to say he considers it misleading to state "that the molar teeth in the fragment not only approach the ape form, but are in some respects identical. These two molar teeth are absolutely human, the difference between them and those of the anthropoids in the arrangement of the enamel alone being quite unmistakable." Any fresh evidence bearing upon the problem of the mandible is of importance, and it is to be hoped that Mr. Underwood will publish at an early date, with illustrations, the evidence he has obtained of "unmistakable" characters in the arrangement of the enamel.

According to the report for 1912, the authorities of the Rhodesia Museum, Bulawayo, are considering a scheme for the erection of a new west wing to the building, at an estimated cost of about 1400*l*. The curator reports that as much progress as could reasonably be expected, when the funds at his disposal are taken into consideration, has been made in the development of the museum during the year under review.

We have received No. 39 of Dr. Schulze's *Das Tierreich*, a fasciculus of 210 pages, devoted to that group of malacostracous crustaceans known as Cumacea or Sympoda. The author is the Rev. T. R. R. Stebbing, who has already contributed to this work the memoir on the gammarid amphipods (No. 21), and who, as in that fasciculus, writes in English. In deference to the usage in the rest of the work, Mr. Stebbing surrenders his favourite practice of treating all generic names as masculine, and on similar grounds he retains the older name Cumacea for the group in place of Sympoda. The objection to the use of the former is based on the cancelling of the generic term Cuma; but although this bars the employment of the family name Cumaidæ, it does not, in our opinion, entail the abolition of the ordinal designation. On the other hand, it is a pity that some objection could not have led to the abolition of such a name as "Vaunthompsoniidæ." The work is worthy of the high reputation of its author as a specialist in the group of animals with which it deals.

We have received a prospectus of an interesting publication to be issued by the naturalists of the Biological Station in Heligoland. The proposal is to issue a series of plates of instantaneous photographs illustrating the living marine animals and plants of the North Sea. The specimen proof that has been forwarded with the prospectus is an extremely beautiful photograph of the jelly-fish, *Cyanea lamarcki*, showing the numerous delicate tentacles in their natural position during life. Other photographs of the series were exhibited at the International Congress of Zoology at Monaco, and created much interest and admiration. Each plate will be accompanied by six pages of description, and the publication will be of quarto size. The price, 8 marks for each part of ten plates, is not excessive. The series will be published by Werner Klinkhardt, of Leipzig, with the title, "Tier- und Pflanzenleben der Nord See."

It is well known that the loss of life during earthquakes in Italy, which in some towns has amounted to more than half the population, is largely due to the faulty construction of the houses. Prof. Omori indeed estimates that 998 out of every thousand persons killed in Messina in 1908 were victims of such defects. The construction of new buildings in the seismic districts is governed by stringent regulations both as regards site and design. Dr. Agamennone, however, suggests in a recent paper (*Rivista di Astronomia*, September, 1913) that these regulations should be supplemented by periodic inspection, and, if necessary, strengthening, of all existing houses.

The Times for November 25 contains an article from its Panama correspondent on the recent earthquakes felt in the canal zone. The strongest shock of the series was that which occurred on October 1, but it seems to have caused little damage except at Los Santos, which is about a hunderd miles from the canal. The writer considers the effects of a fault-displacement through the Gatun dam or the locks at the ends of the canal, and shows without difficulty that the result in either case would be disastrous. It seems unnecessary, however, to take into account a contingency so remote. The danger, if danger there be, is more likely to arise from the secondary effects of a strong shock occurring within a comparatively short distance from the canal. So long as the epicentres remain in a region a hundred miles or more from the canal, the risk of such damage must be small.

Although the crest of the Appalachian chain has long been known to form a line of division between two more or less distinct fresh-water faunas on its opposite flanks, the fact that a similar condition, in a more pronounced degree, holds good in the case of the Alleghenies has been to a great extent overlooked. In order to fill this gap in our knowledge, Dr. A. E. Ortmann has undertaken an investigation of the faunas of the various streams, based chiefly on the fresh-water mussels or naiads, but also including certain other groups, such as crustaceans, the results of which are published in vol. lii., No. 210 (pp. 287–390), of the Proceedings of the American Philosophical Society. It is considered that the Allegheny system forms an ancient and well-marked boundary between the fresh-water fauna of the interior basin and that of the Atlantic slope. In the former area the fauna of the upper Ohio basin is characterised by its uniformity—a feature acquired in post-glacial times; but on the western side there are indications of a pre-glacial faunistic differentiation. On the other hand, the marked distinctness of the Atlantic fauna is held to justify the foundation of two faunistic provinces—Mississippian and Atlantic—despite the fact that the fauna of the latter is a derivative from that of the former area. The Atlantic fauna is divisible into a northern and a southern group; and a dispersal line directed both north and south is recognisable on the Atlantic slope. Finally, a few cases in the mountains point to a crossing of the divide; while on the Atlantic side there occur certain instances of abnormal distribution which demand special explanation.

The synoptic weather maps for November 7–13 included in the first issue of the Meteorological Office chart of the North Atlantic for December exhibit a very striking feature of the distribution of atmospheric pressure. The useful notes which accompany the maps explain that an extensive and deep cyclonic system lay almost stationary athwart the Transatlantic steamer routes, and remained there persistently for some days. There was a complete wind-circulation, but only few records of gales. Another deep disturbance lay over the American Lake region, and exceptionally violent gales were reported there. The abnormally mild type of weather over this country and western Europe was due to the ocean depression above referred to. The two disturbances were separated by a ridge of high pressure, extending across Newfoundland towards Davis Strait.

During the ice season of this year patrols in the North Atlantic were undertaken by the U.S. revenue cutters *Seneca* and *Miami*, and very interesting reports of the cruises of both vessels are contained in the Pilot Chart of that ocean for October, issued by the U.S. Hydrographic Office. The following notes are taken from the observations and deductions made by Capt. Johnston during the cruises of the former vessel. All the ice seen on or near the Grand Bank was of the Greenland type, in berg form. The largest berg seen was about 400 by 300 ft., the height above the water being 70 ft.; as to shape, no two bore any striking resemblance to each other. The only type not seen was the kind popularly pictured in school books, with overhanging, craggy pinnacles. The greatest distance at which ice was observed was eighteen miles, on a clear day. With the searchlight a berg could be seen about three miles on a dimly moonlight night, but owing to the blinding effect on the observer, its general use for a vessel under way is not recommended. A berg may or may not give an echo; about 90 per cent. of attempts made were without result, so that the absence of an echo proves nothing. Sudden changes of sea temperature mean nothing so far as bergs are concerned, and as a rule little or no change was found in the air temperature near a berg. In Capt. Johnston's opinion, the only safe way to navigate regions of icebergs is to stop during thick weather and to run very slowly on dark nights.

In the Proceedings of the Royal Society of Edinburgh for 1910 Mr. J. B. Ritchie showed that the amplitude of the nth torsional oscillation of a weight supported by a thin wire was inversely proportional to a power of $n+n_0$, where n_0 is a constant depending on the material of the wire. In the Proceedings for 1912–13 Prof. W. Peddie carries the investigation of the problem a step further by showing how the oscillations themselves are performed. To do this he provides the lower surface of the oscillating body with a number of pins, which make contact with mercury placed in slits in the top surface of an ebonite disc. The resulting currents operate the recorders of an electrical chronograph. He finds that the period of the motion towards, is distinctly greater than that away from, the equilibrium position, and that throughout the whole of the former and the first part of the latter path the motion is of the simple periodic type. Both these results, he shows, can be explained on the assumption that the motion when it exceeds a certain magnitude breaks up molecular groups in the suspending wire.

An important paper on the phenomena occurring in solutions of radio-active products was read by Dr. T. Godlewski before the Academy of Sciences at Cracow on June 2, and also published in *Le Radium* for August last. In the experiments described a solution of radium emanation with its disintegration products in pure water was electrolysed. Radium A appeared at the anode and radium B at the kathode, while radium C was deposited in about equal quantities at both the anode and kathode. The nature of this deposition points strongly to the supposition that the products are present in the colloidal state and not as ions, the radium A forming negative, radium B positive, and radium C both negative and positive suspensions. This assumption was verified by experiments on the effect of adding small amounts of different electrolytes, such as HCl, NH_4OH, $Al_2(SO_4)_3$, and $K_3C_6H_5O_7$, which are known to affect the speed and direction of transportation of such suspensions. For instance, the H ions obtained by adding HCl in very small concentration (0·00003 normal) were shown to diminish the number of negative suspensions of radium A, and increase the number of positive suspensions of radium B. With further increase in concentration of HCl the radium A atoms begin to appear at the kathode. The action of basic ions was also shown to be very pronounced, and in the opposite direction to that of acids. The assumption that the products in neutral solution are present as colloids is also supported by recent experiments of Paneth, who has shown that polonium can be separated from lead by allowing the latter to diffuse through an animal membrane.

Parts 1 and 2 of the Science Reports for 1913 of the University of Sendai, Japan, contain a series of papers by Prof. Honda and his pupils on the magnetic properties of ferro-, para-, and dia-magnetic substances and the effects of temperature upon them. For ferromagnetic substances the observations cover the effect of temperature on the intensity of magnetisation at various fields, the temperature at which magnetic changes occur and the heat developed or absorbed during the process. A magnetometric method was used. Soils were investigated by the torsion balance method, the specimen being placed in a magnetic field for which $H dH/dx$ was known. The susceptibilities were found to decrease as the temperature rose and to reach a value nearly zero between 500° and 600° C. They decreased also with increasing magnetic fields. Many alloys of antimony, lead, aluminium, zinc, tellurium, tin, and bismuth were investigated by the same method to test the influence of composition on susceptibility. In no case does it appear possible to calculate the susceptibility of such alloys from those of their constituents, and in almost all cases the alloys having their constituents in simple atomic proportions display characteristic magnetic properties.

Circular No. 42 of the Bureau of Standards, Washington, deals with metallographic testing, and contains a concise account of the scope of the subject, thermal analysis, and microscopic analysis, followed by full directions for preparation and forwarding the samples. Circular No. 25 of the same bureau contains general information regarding standard analysed samples. Details are given of the precautions taken in manufacture to secure pure and homogeneous samples. Before the final bottling, samples for analysis are removed from the jars and sent, one each, to a number of analysts. In general three types of analysts are chosen—commercial chemists, works chemists, and chemists of the bureau. When all the analytical results have been received they are inspected, and, if not sufficiently concordant, analysts are sometimes requested to repeat the determinations without knowing the direction from the mean in which their value lies. The standard samples include various steels, zinc ore, iron ores, naphthalene and sugar for calorimetric standards, benzoic acid, for calorimetry and for alkalimetry, and sodium oxalate. The prices are moderate, averaging two dollars for quantities of 50 to 150 grams.

The Transactions of the American Institute of Chemical Engineers (vol. v.) contains a paper by A. S. Cushman and H. C. Fuller, of the Institute of Industrial Research, Washington, upon a chemical investigation of Asiatic rice. So far as the results of analysis can be interpreted in the light of the information at hand, the authors conclude that there appears to be no reason why the white milled rices from one section of the world should be held more responsible for malnutrition than similar rices from other parts. In the same volume J. C. Olsen and A. E. Ratner contribute a paper upon the decomposition of linseed oil during drying. While oxygen is absorbed, water and carbon dioxide are given off, the effect upon the weight of the oil being shown. The opacity and hiding power of pigments forms the subject of investigation by Mr. G. W. Thompson. For the purposes of these experiments an apparatus was devised consisting of a photometer which brings two fields of light into juxtaposition, so that they can be compared by the eye. This photometer is placed on top of two tubes, the lower ends of which have lenses. Paint placed between one set of lenses can be compared with a standard paint or with pieces of paper which have been tested on a photometer bench. Mr. M. C. Whitaker contributes a paper on the chemical engineering course and laboratories at Columbia University. The course provides for post-graduate students who have taken a university degree. It has been observed that for several years more than 20 per cent. of the students of engineering at Columbia have possessed the college degree at entrance.

A COPY of Merck's annual report on recent advances in pharmaceutical chemistry and therapeutics has recently reached us. Lecithin is taken as the subject of the special monograph this year, and some seventy pages are devoted to it. In these are given an account of the chemistry and physiology of the lecithins, a discussion of the rôle which they are believed to play in the phenomena of metabolism and nutrition, and a summary of the results obtained with them in therapeutical experiments. A large amount of work has been done on these bodies, and students will find this account a convenient bird's-eye view of the subject. An extensive bibliography of lecithin literature is appended; both this and the description of the analytical tests will be found useful. Another special feature of the report is a supplement giving a detailed account of the methods used for the physiological standardisation of digitalis preparations in the Pharmacological Institute, Erlangen University. Gratusstrophanthin is used as the standard toxic substance for comparison, the subjects being frogs, mice, rabbits, and cats. Among the ordinary records may be mentioned as of special medical interest those on salvarsan and neo-salvarsan, chineonal, mesothorium, hypophysis preparations, and nucleinic acid; whilst the attention of analysts may be directed to those on cobalt-sodium nitrite, hydrazine sulphate, blood tests, uranium acetate in the determination of albumen, and the use of dimethyl-glyoxal as a reagent for nickel and ferrous iron.

IN his second lecture to the Institute of Chemistry on "The research chemist in the works, with special reference to the textile industry," Mr. W. P. Dreaper directed attention to the importance of a knowledge of theory, and illustrated this point by a reference to the work done in connection with the presence of stains and loss of strength experienced on the storage of certain silk goods. These faults were found to be due to the free sulphuric acid. Only a knowledge of theory could suggest why this acid could be present in cases where it had never been used in any process of manufacture. The so-called "neutral salt reaction" had offered a solution to this problem, and has relieved the dyer from constant blame. Continuing, he said the British aniline dye industry has recently made remarkable progress, and its products are even being sold in Germany. The future will see considerable expansion in this reviving industry.

IN an address recently delivered before the Calcutta Chemical Club Prof. P. C. Rây emphasises the extraordinary progress made by chemical research in Bengal during recent years; in the session 1912–13 alone more than sixty contributions were published from the chemical laboratory of Presidency College by Prof. Rây and his students. Owing to the recent munificent gifts of Sir T. Palit and Dr. Rashbehary Ghosh, it has become possible to found a University College of Science in Bengal, which it is hoped will bring about a renaissance of the scientific spirit in India. It is noteworthy that Dr. Ghosh has expressed the opinion that the higher academic degrees should be conferred only on those who have done original research work. He would abolish examinations for these degrees and make research work the only qualifying test, and Prof. Rây cites a case in which one of his recent students who was "plucked" in the B.Sc. examination, has since shown conspicuous ability in research, and is deserving of the highest degree.

The Engineering Magazine for November contains an illustrated article by W. Wilson, dealing with the development of Auckland Harbour, New Zealand. Nine years ago, when the present engineering staff took up their duties, a wooden wharfing scheme was in existence. Various timbers had been used in its construction, but every available wood was destroyed by an energetic species of Teredo. Even wood that is nearly impervious in Australian waters is attacked here. Ferro-concrete construction has been adopted, and after about seven years' trial has proved an entire success; while the prevailing mudstone on the shores of the harbour is riddled with molluscs, the concrete is quite proof against attack. The article has several photographs showing the condition of the old wooden piles; inspection of these illustrations indicates that the Auckland Harbour Teredo does its work in a most thorough fashion. Often only three years is required to honeycomb even the hardest timber.

THE seventh part of Dr. Koningsberger's *Java* is devoted to the faunas of open fallow lands and of fields which have been long under cultivation, the last chapter, dealing with the fauna of cacao plantations. On p. 311 the author speaks of the black-necked *Lepus nigricollis,* which haunts the fallows, as the Javan hare, whereas, according to Blanford, it is naturally restricted to southern India and Ceylon, whence it has apparently been introduced into Java.

WE have received from Washington a catalogue giving prices and carefully worded descriptions of the publications of the Carnegie Institution. Copies of each of the works, except the "Index Medicus," are sent gratuitously to a limited number of the greater libraries of the world, while the remainder of the edition is sold at a price sufficient only to cover the cost of publication and of transportation to purchasers. The catalogue concludes with an index of authors with condensed titles of their works. Copies of the catalogue may be obtained on application to the Carnegie Institution, at Washington, D.C., U.S.A.

THE issue for 1914 of *The Scientists' Reference Book and Diary,* has been received from the publishers, Messrs. Jas. Woolley, Sons, and Co., Ltd., of Manchester. The reference book contains useful chemical and physical constants, glossaries of scientific and technical terms, and a miscellany of useful information. The diary is compact and conveniently arranged. The volumes are contained in a neat leather case of pocket size. The price of this popular diary is 2s.

OUR ASTRONOMICAL COLUMN.

THE RADIAL VELOCITY OF THE ANDROMEDA NEBULA.—*Lowell Bulletin* (No. 58) contains an important communication by Mr. V. M. Slipher, which gives a first approximation to the radial velocity of the Andromeda nebula. Mr. Slipher used the 24-in. of the Lowell Observatory, with a camera of very short focus, a wide slit, and a very dense prism of 64°. The first of the series of spectrograms was exposed for 6h. 50m., but no mention is made as regards the lengths of the exposures of the other plates. The observations recorded are as follows:—

1912	Velocity
September 17	−284 km.
November 15–16	−296 ,,
December 3–4	−308 ,,
December 29–30–31	−301 ,,
Mean velocity	−300 ,,

Mention is made that tests for determining the degree of accuracy of such observations have not been completed, but the mean value is stated to be within the accuracy of the observations. As the Andromeda nebula is typical of a very great number of nebulæ it will be interesting to know whether other spirals have a movement of the same order, and thus exceed as a class the velocities of stars. The faintness of spiral nebulæ renders the accumulation of data on this point a very slow process, but an attack on a few of the brighter ones would be of great importance and might indicate the general tendency of the velocity magnitude.

PHOTOGRAPHIC MAGNITUDES OF COMPARISON STARS IN CERTAIN OF THE HAGEN FIELDS.—It was with the object of establishing the photographic magnitudes of stars which might be used as standards for comparison in the Hagen fields that Mr. C. H. Gingrich undertook the research which he describes in the October number of *The Astrophysical Journal*. The instruments available at the Yerkes Observatory for the research were a 6-in. Zeiss ultra-violet camera and a 2-ft. reflector; the former instrument was used for the bright stars, and the latter for faint stars, though in this case the exposures were considerably lengthened owing to the necessity of having to cut the aperture down to 1ft. Mr. Gingrich describes in some detail the programme of exposures and the methods of measurement and reduction. The results are summed up in ten tables, each including a field.

THE HARMONIC ANALYSER APPLIED TO THE SUN-SPOT CYCLE.—In a recent number of *The Astrophysical Journal* (October, vol. xxxviii., No. 3) Prof. A. A. Michelson gives the results of a determination of periodicities by the harmonic analyser with an application to the sun-spot cycle. The method employed is to obtain the values of the coefficients of a Fourier series by a mechanical integration by the harmonic analyser. The function to be treated is copied on the machine, which then draws a curve the ordinates of which at given distances along the axis of abscissas are proportional to the coefficients of the corresponding Fourier series. In the present paper he gives a few test illustrations of the performance of the machine, and refers to a similar treatment of the sun-spot curve, as furnished in the paper by Hisashi Kimura, entitled "On the Harmonic Analysis of Sunspot Relative Numbers," printed in the Monthly Notices, R.A.S., May, 1913, p. 543. Prof. Michelson concludes his paper with the statements that it would seem that with the exception of the eleven-year period and possibly a very long period (of the order of 100 years) the many periods found by previous investigators are illusory. He adds that it will probably be found that even the eleven-year period is, in fact, not constant, but is subject to secular change.

RZ. CASSIOPEIÆ.—A research by Herr K. Graff on this important short-period eclipsing binary system is published in No. 13, *Mitteilungen der Hamburger Sternwarte*. It is pointed out that this system is pre-eminently fitted for study with small instruments since it is circumpolar, occupies a well-marked position lying in the prolongation of the line ϵ to ι Cassiopeiæ, the range of magnitude is important (6·36 to 7·69 in the course of rather less than three hours), and it has a very short period, 1·19525d.

THE NANTUCKET OBSERVATORY.—The new $7\frac{1}{2}$ in. photographic telescope has been placed in position in the Memorial Observatory of the Nantucket Maria Mitchell Association. The observatory has, in addition, a 5-in. Alvan Clark visual telescope, a filar micrometer, and a micrometer for measuring stellar spectra. The Nantucket Maria Mitchell Association has awarded the fellowship of 200*l.* for the year beginning June 15, 1914, to Margaret Harwood. In order that the observatory may be provided for from June 15, 1915, to December 15, 1915, the association offers a second fellowship of 100*l.* for the quadrennial year under conditions similar to those which have governed the 200*l.* fellowship. The committee reserves the right to withhold the second 100*l.* fellowship in case the work presented to the examiners should not in their judgment be of sufficient merit to deserve the award.

CONVERGENCE IN THE MAMMALIA.

THE discussion on convergence in mammalia in Section D at the recent meeting of the British Association was, to some extent, a consideration of matters kindred to several dealt with by Dr. Gadow in his presidential address. In his prefatory remarks Dr. Gadow referred to the importance of perceiving convergent resemblances, and said it was of more value to understand how and why, for instance, even a small but essential Cetacean feature had been brought about than to refer it back to some "Ur-Cetacean," which would still remain a mystical conception.

Prof. Dollo discussed a new case of convergence, namely Balæna and Neobalæna. He pointed out that Neobalæna, a whale with long whalebone, and found in the southern hemisphere, had been considered hitherto either as a true right-whale or as intermediate between the right-whales and the fin-whales. He held that Neobalæna does not belong to the right-whales, and that all the characters which it possesses in common with them are adaptations. Nor is Neobalæna intermediate between the right-whales and the fin-whales, but belongs to the latter group, for all the features which it has in common with the fin-whales are hereditary characters. Rhachianectes is not a primitive fin-whale; it is very specialised and secondarily adapted to littoral life and to its mytilophagous habit. Its hyperphalangy bears witness to its former pelagic life, and its shortened whalebones to its former plankton-feeding habit. The Mystacoceti should be divided into (1) Balænoidea, including a single family—the Balænidæ, with long whalebones, and (2) Balænopteroidea, comprising three families—Balænopteridæ, with short whalebones, Rhachianectidæ, with regressive whalebones, and Neobalænidæ, with long whalebones. Neobalæna is an example of positive convergence with Balæna by independent acquisition of the longibarbous character, and, on the other hand, is an example of negative convergence with Rhachianectes by reason of the loss of the throat-grooves.

Prof. van Bemmelen cited cases of convergence and then proceeded to discuss the relationship between the hare and the rabbit. Having compared these, as well as the different subgenera of Lepus with each other, he felt obliged to assume that the adaptation of a free-living, hare-like duplicidentate to a fossorial mode of life had taken place several times in different parts of the world and in different geological epochs. All rabbit-like members of the family did not form one well-circumscribed group, as opposed to the hare-like members, but they represent a number of side-branches emerging on different levels from a stem which itself leads from primitive hares like the Sumatran Nesolagus to the most highly developed species, *Lepus europaeus*. He pointed out that Ornithorhynchus and Echidna, especially the latter, are highly specialised forms, the more generalised ancestors of which have disappeared. The similarities between these two animals in many points are consequences of convergence and not of homology, *e.g.* the loss of teeth, the retrogression of the internal nares and corresponding elongation of the bony palate. This similar structure of palate has arisen in spite of the different diets of these animals. The factor in the case of Ornithorhynchus was the necessity of breathing while partially submerged (*cf.* the crocodiles and Cetacea), and in the case of Echidna, as in other ant-eaters, the necessity of preventing the living prey from entering the nasal passages.

Dr. Versluys discussed the subject from the philosophical aspect. He pointed out that convergence is so common in mammals that we are inclined to look for some special cause. Why does adaptation nearly always follow the same lines, as if no other way were possible? Is it because the power of natural selection is unlimited so that it can modify any original structure until in every case the one best adaptation is reached, or is the reverse true, *i.e.* is the possibility of modification so limited that, though several adaptations might be equally effective, yet only one can be followed, pre-indicated either by a limited variability or by some hereditary tendency? Nowhere is this similarity of adaptive structure more striking than in the teeth of mammals, and Osborn concluded that there must be operating here some law of predisposition—the influence of hereditary kinship. If such a law be accepted the great abundance of parallel adaptation might be referred to a tendency inherited from a common ancestor, and natural selection could foster these tendencies only where they become useful. Sometimes, however, an astonishing convergence is found in distantly related mammals, *e.g.* the Eocene primate Notharctus exhibits a tooth-pattern closely resembling that of Eocene horses. If we assume some hereditary tendency in this case it must have been present in the very primitive mammals which were the common ancestors of both those forms, and from which also a large proportion of placental mammals must have sprung. It would further be necessary, however, to accept a primitive tendency to form several other tooth-patterns, which became useful and developed only a long time afterwards. If we refuse to accept the presence of some hereditary tendency in the case of Notharctus, why should we accept it in other cases where the parallel modification of structure in more closely related animals would not constitute so difficult a task for natural selection? If we do not accept the hereditary tendency it is necessary to ascribe a very great modifying power to natural selection.

Dr. Versluys pointed out in conclusion that the study of convergence brings us into contact with some of the most important problems of the doctrine of evolution (which it may assist in solving), the problem of the power of natural selection and the survival value of small variations, and the problem of the presence of hereditary tendencies in variation and adaptation.

Dr. W. K. Gregory exhibited and commented upon several groups of specimens illustrating convergence. He pointed out that in many cases of convergence there is a likeness of material or a general homology to begin with, as in the evolution of the carnassial teeth in the Hyænodontidæ and Canidæ, where, although the evolution had taken place in different teeth (the fourth upper premolar in the Canidæ and the second upper molar in the Hyænodontidæ), yet the tissues involved were the same in the converging groups. Sometimes, however, convergence took place between structures formed from quite different tissues, as in the dentition of Thylacoleo and the not dissimilar shearing structures of Dinichthys—in the former case true teeth, in the latter sharpened edges of bone. Dr. Gregory pointed out finally that great advances have been made in the detection of cases of convergence, *e.g.* among the extinct Patagonian Sparassodonts. J. H. A.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

IN a retrospect of the proceedings of Section H at Birmingham, first place must be given to the discussion on the practical application of anthropological teaching in universities, which was opened by the president, Sir Richard Temple, who, speaking with the authority of an old administrator as well as an anthropologist, pointed out the advantages which would follow did the future administrators of our subject races receive some training in anthropology before taking up their duties. He suggested that the organisation of a school for this special purpose, well equipped with library and museum, might well be undertaken by one of the newer universities, such as Birmingham. Sir Richard, at the close of his remarks, quoted extracts from letters received from Sir R. Wingate, Sir F. Swettenham, Sir George Scott, Prof. Seligmann, and others, in which his proposals received strong support. In the discussion which followed, Sir Everard im Thurn, late High Commissioner in the Pacific, Mr. W. Crooke, and Colonel Gurdon of Assam, endorsed the president's views as to the desirability of the proposal from the administrative point of view, while Dr. Haddon, of Cambridge, Dr. Marett, of Oxford, and Prof. P. Thompson, of Birmingham, made suggestions as to the general lines upon which such a school might be organised, and gave a brief account of the anthropological instruction already given by their respective universities. The discussion has aroused much interest, and it may be hoped that the committee which has been appointed to consider the question will make some practical proposal to which effect can be given by one of the existing schools or a school still to be established.

Turning to the other proceedings of the section, it may be said that the general level of interest of the papers was high. The programme was exceedingly long, so much so that on two occasions it was necessary for the section to divide, the joint discussion with the Section of Educational Science on the educational use of museums being attended by part of the section only, including the president and Dr. Haddon, while the papers on physical anthropology were presented to a subsection over which Sir Edward Brabrook presided. The papers in physical anthropology, which were followed with close interest by a large audience, included a group of three papers of a somewhat speculative character on the evolution of man from the ape, the first by Prof. Carveth Read, dealing with the consequences—physical, mental, and social—following from the preference for a meat diet, which differentiates man from the other primates; a second by Dr. Harry Campbell on the essentially mental character of man's evolution, the pre-human anthropoid, being only imperfectly equipped as a beast of prey, and having in consequence been compelled to rely upon the development of his intelligence; and a third by Dr. L. Robinson on the relation of the jaw to articulate speech and its effect on the development of the chin. In the discussion which followed, Prof. Elliot Smith briefly referred to his own position with regard to the part played by the brain in the evolution of man, as set forth in his presidential address at Dundee, and with special reference to Dr. Robinson's paper, said that, in his view, it was not the conformation of the jaw which made speech possible, but the acquisition of speech which developed the jaw; the absence of the genio-glossal muscle and the chin in the Piltdown skull proved nothing as to the power of speech. Prof. Fleure and Mr. T. C. James then gave an account of the further results of their anthropometric survey of Wales, especially in relation to the distribution of racial types, and Prof. Petrie described the early Egyptian skeletons discovered in his excavations, with special reference to the traces of racial admixture discernible in skeletal remains of the early dynasties found at Tarkhan and due to an invading minority race of the first dynasty.

Among the ethnographical papers, considerable interest was aroused by Mr. T. W. Thompson's paper on the tabus and funeral customs of the gypsies, in which, as the result of a close analysis of the customs of both English and Continental gypsies, he was able to show that these were distinctly gypsy in character, while the marriage customs tend to conform to the customs of the country of habitat. Dr. Rivers and the Rev. J. Hall, in a joint communication on a gypsy pedigree, that of the Heron family, were able to demonstrate a number of facts of sociological and biological interest as to the gypsy family and marriage. Prof. W. J. Sollas, in a communication on the relative age of the patrilineal and matrilineal tribes of south-east Australia, discussed the evidence—physical, linguistic, and cultural—which appeared to point to the increasingly primitive character of the tribes from north to south—a conclusion which, as might be expected, was in agreement with the usual assumption that Australia and Tasmania had been peopled from New Guinea—and suggested further that the evolutional change had been from Kurnai through Kulin to Narrinjeri. Mr. E. S. Hartland put forward a warning against the uncritical acceptance of the historical traditions of the Baganda and the natives of the Congo, while Mr. Crooke in like manner was able to show by an examination of marriage customs that there was less stability in the caste and tribal systems of India than Risley had supposed when considering these aggregates as affording an unequalled opportunity for the application of anthropometric methods.

Nearly the whole of one morning's session was devoted to papers dealing with seasonal customs in various parts of the world; Dr. Rivers, in a communication on sun cults and megaliths in Oceania, pointed out the coincidence in the distribution in this region of these monuments and the existence of secret societies, the rites of which might, either by direct evidence or by inference, be connected with the sun cult, an exception, however, being found in the island of Tonga, where there was no evidence for the sun cult. Miss Burne dealt with the seasonal customs of "souling," "catterning," and "clementing" in the western Midlands, which she connected with the beginning of the Celtic year in November, and Mr. J. H. Powell suggested that the custom of hook-swinging in India, which he assigned to a Dravidian origin, was a commutated form of human sacrifice. Miss M. Murray discussed the evidence for the practice of killing the king in ancient Egypt. In her view the evidence for human sacrifice was conclusive, and so far Dr. Frazer's theory of a vegetation spirit was the only one which covered the facts. Mr. W. J. Perry, in a communication dealing with the practice of orientation of the dead in Indonesia, pointed out that in all cases the direction indicated lay towards the home of the dead, and suggested that in this direction lay the place of origin of each people in question. Dr. G. Landtman described the ideas of the Kiwai Papuans regarding the soul, which this people look upon as separable from the body in life as well as in death; in the former case its appearance constitutes an omen, sometimes foretelling misfortune to the owner; and Miss Czaplicka demonstrated the effect of environment upon the religious beliefs of the inhabitants of north-east Siberia, the tundras of the north producing a religious dualism in which a belief in "black spirits" prevails, family shamanism is more important than professional shamanism, and want of light and suitable material produces a poor shamanistic apparatus and a poor myth ritual; while in the more open and more favoured steppe country a belief in "white spirits" and an anthropomorphic and imaginative mythology are found. Major Tremearne supplemented the studies of the Hausas which he had submitted to the section at the Portsmouth meeting of the association by a description of Hausa magical practices and an account of the Bori, or spirit cult, of the Hausas of Tunis and Tripoli. Mrs. Charles Temple, in her analysis of the social customs of the pagan tribes of Northern Nigeria, which was drawn largely from official reports, gave an object-lesson of the work, valuable both to the man of science and to the official, which is possible under an intelligent and enlightened administration.

Archæology usually takes a prominent place in the proceedings of the section, and this year was no exception to the rule. Prof. Petrie's account of excavations at Tarkhan, on a site near Gerzeh, and at Memphis, of remains of the first, the twelfth, and the eighteenth and nineteenth dynasties, carried out by the British School of Archæology in Egypt, attracted a large and appreciative audience. His discoveries of Tarkhan, where the preservation of the tombs is remarkable, have revealed much of the civilisation of the people, apart from the king and court, while, as he pointed out, this site may be regarded as of the highest importance in the study of the meeting of the prehistoric and earliest historic races of Egypt. Prof. G. Elliot Smith traced the dolmen to the typical Egyptian tomb of the pyramid period, imperfectly copied in a degraded form in a foreign land where skilled workmen were unobtainable.

Prof. J. L. Myres's valuable contribution to the archæology of Cyprus was based upon a recent re-examination of the Cesnola collection in New York Metropolitan Museum, which had enabled him to extend the upward time limit of the great series of votive statues to a period when Assyrian influence was not yet fully developed, and Syro-Cappadocian affinities were discernible, and to show that the Minoan costume extended in ceremonial, possibly in common, use, well into historical times, while the Cretan syllabary was found to contain elements linking it on to the Minoan script. Mr. G. A. Wainwright, in discussing the origin of the Keftiu, usually identified with the Cretans, demonstrated by a detailed analysis of the evidence of the Egyptian monuments, that their culture was more nearly allied to the Syrian than the Ægean type. Mr. R. Campbell Thompson explained his system of decipherment of the Hittite inscriptions, and in another communication described a large number of ancient Assyrian medical charms and remedies from inscribed tablets still unpublished. The evidence bearing upon the character and powers of the female magician in Semitic magic was analysed and discussed by Prof. T. Witton Davies. Dr. T. Ashby, director of the British School at Rome, described the successive systems of aqueducts in ancient Rome, and gave an account of a recent attempt to trace the Via Appia, in the course of which he discovered four menhirs near Bari not hitherto described.

The archæology of western Europe was covered by communications from Dr. Marett, describing recent discoveries of Palæolithic and Neolithic age in the Channel Islands, and from Mr. Cantrill on stone boiling in the British Isles; from Mr. H. Peake on the Bronze age in the Rhone Valley, and Mr. O. G. S. Crawford on trade between England and France in the Neolithic and Bronze ages. Mr. W. Dale, in describing an exhibit of flint implements found in the county of Hampshire, raised the question of the dating of the rough "celt" usually assigned to the Neolithic period, but unfortunately owing to lack of time no discussion was possible. Mr. J. P. Bushe-Fox described the excavations on the site of the Roman town of Viroconium, which are being carried out under the auspices of the Shropshire Archæological Society and the Society of Antiquaries, and Dr. Willoughby Gardner gave an account of his further excavations of the Romano-British hill-fort in Kinmell Park, near Abergele. Dr. T. J. Jehu and Mr. A. J. B. Wace described their discoveries in excavating the Kinkell Cave, near St. Andrews, which had been inhabited in Roman and early Christian times. These included a slab of red sandstone with incised crosses, which the authors held to be probably one of the earliest relics of Christianity yet found in Britain. Papers by the Rev. F. Smith, on Palæolithic trap stones, and by the Rev. Dr. Irving, on the prehistoric site at Bishops Stortford, brought to a close one of the most successful meetings of recent years.

OCEAN TEMPERATURES NEAR ICEBERGS.

THE Journal of the Washington Academy of Sciences for September 19 contains, *inter alia*, an account by Messrs. C. W. Waidner, H. C. Dickinson, and J. J. Crowe, of the Bureau of Standards, of observations on ocean temperatures in the vicinity of icebergs and in other parts of the ocean taken by them on board the United States' steamships *Chester* and *Birmingham*.

The party, which left Philadelphia in the *Chester* on June 2, 1912, and was subsequently transferred to the *Birmingham*, registered continuous observations from June 19 until its return to Philadelphia on July 11 of the same year.

The temperature equipment carried consisted of a surface electrical resistance thermometer, a Leeds and Northrup recorder suitable for use with the resistance thermometer, deep sea thermometers, and several mercurial standard thermometers.

Several small bergs were seen on the horizon from the *Chester* on June 17, and almost simultaneously the temperature record indicated a sudden fall from 8·7° to 7·3° C. The fall continued while the berg was approached, and at a distance from it of about 500 yards the temperature was 5·7° C.

At a distance of about 150 yards from the berg, the mass of which was estimated at about 1200 tons, the surface temperatures taken from a boat ranged from 5·8° to 6·7° C. Other observations taken gave the following temperatures: 20 ft. from the berg, 4·5°; 35 ft., 4·9°; 50 ft., 5·0°; 75 ft., 5·4°; 200 ft., 5·7° C.

At a depth of five fathoms, when 50 ft. from the berg, the temperature was 3·6° C., and at 20 fathoms 3·3° C. At some miles distant from the berg, however, the temperatures taken were as low as those observed a few feet from it; moreover, an examination of temperature records, which were obtained under a variety of conditions, in the region of 37° to 43° 30′ north latitude and 43° to 53° west longitude, demonstrated the difficulty of separating large and sudden variations of sea temperature, so frequently met with, from variations that might be caused by the proximity of icebergs.

In some parts of the ocean, temperatures were recorded that were constant to a few tenths of a degree for many hours, whereas in other parts the variations were as large and sudden as any observed in the neighbourhood of icebergs.

The variation in the salinity of sea-water in the vicinity of bergs, resulting from the melting of the ice, were so small as to be masked by the ordinary variations found in sea-water.

Experiments with the foghorn, sounded when in the vicinity of icebergs, with the object of detecting their presence in a fog by the echo from them, were tried without success; but a few experiments made with a bell sounded under water to ascertain whether an echo from the submerged portion of a berg could be detected by means of the ship's submarine signal telephones were attended with more hopeful results.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Huxley lecture for this year is to be delivered by Sir Arthur Evans, F.R.S., who has chosen as his subject, "The Ages of Minos."

CAMBRIDGE.—The Vice-Chancellor gives notice that the Lowndean professorship of astronomy and geometry is vacant by the death of Sir Robert Ball. The electors will meet for the purpose of electing a professor on Monday, December 22. Candidates are requested to send their names, with ten copies of such testimonials, if any, as they may think fit, to the Vice-Chancellor on or before Monday, December 15, 1913.

Mr. N. Cunliffe has been appointed to the office of assistant to the superintendent of the museum of zoology for one year as from October 1, 1913.

The Walsingham medal for 1913 has been awarded to Mr. F. Kidd, for his essay entitled, "On the Action of Carbon Dioxide in the Moist Seed in Maturing, Resting, and Germinating Conditions."

Mr. H. S. Jones, formerly foundation scholar, Isaac Newton student 1912, Smith's prizeman 1913, has been elected to a fellowship at Jesus College.

LONDON.—Dr. W. T. Gordon has been appointed lecturer and head of the geological department at King's College, in succession to Dr. T. F. Sibly, appointed professor of geology at the University of South Wales, Cardiff. Dr. Gordon has been lecturer in palæontology and assistant in geology at the University of Edinburgh since 1910, and has made extensive researches in palæobotany, and some investigations in stratigraphical geology.

MANCHESTER.—A very interesting and pleasant ceremony was held in the University on Thursday, November 27, when the portrait of Prof. Horace Lamb, F.R.S., was presented by subscribers to the University to be hung in the Whitworth Hall. Prof. Lamb has filled the chair of mathematics in the University of Manchester since 1885, or a period of twenty-eight years, and is now senior professor. An unusual feature of interest lay in the fact that the portrait of Prof. Lamb was painted by his son, Mr. Henry Lamb, a rising young artist. The gathering was well attended by the friends and colleagues of Prof. Lamb, and the presentation of the portrait was made by Prof. Tout and Prof. Rutherford on behalf of the subscribers. Reference was made to the remarkable success of Prof. Lamb as a teacher of mathematics, and to the importance of his original contributions to mathematical physics. The portrait was accepted on behalf of the University by Sir Frank Forbes Adam, the chairman of the council, and very appreciative references were made by Prof. Weiss, the Vice-Chancellor, and by all the speakers, to the esteem and affection in which Prof. Lamb is held by all his friends and colleagues. Letters were read from Dr. Schuster, Sir Joseph Larmor, the Vice-Chancellor of Leeds, and others, who were unable to be present at the presentation, in which they expressed their warm appreciation of the services of Prof. Lamb to the University and to science as a teacher and original investigator. The hope was expressed by all the speakers that Prof. Lamb would long continue to carry on his work in the University which he has served with so much distinction.

Dr. G. Owen, lecturer and demonstrator in physics at Liverpool University, has been appointed professor of physics at Auckland University College, New Zealand.

It is stated in *Science* that a gift of 870,000*l.* to the Cornell Medical School has been officially announced. The name of the donor is withheld, but he is believed to be Colonel O. H. Payne, of New York City.

Sir Thomas H. Elliott, K.C.B., Deputy Master and Comptroller of the Royal Mint, will distribute prizes and certificates at the Sir John Cass Technical Institute, Aldgate, E.C., on Wednesday next, December 10, and will deliver an address. There will be an exhibition of students' work and apparatus in the laboratories and workshops.

In the issue of *Science* for October 24, Prof. F. C. Ferry, writing under the title, "Some Tables of Student Hours of Instruction," gives some interesting facts as to the amount of work done in various American universities in the different faculties. By a "student hour of instruction" is meant the taking of a course of one hour a week by one student through one session. The tables included in the article show that in the order of the relative amount of work done in science and mathematics certain of the American universities stand in the following order:—Leland Stanford Junior, Princeton, Cornell, Wisconsin, Johns Hopkins, Dartmouth, Wesleyan, Amherst, and Columbia. In general, the eastern universities show a greater amount of work in the foreign languages than the western, while the western show much larger numbers in science.

In a note last week attention was directed to the beginning of the new buildings for the Massachusetts Institute of Technology. We notice in *The Boston Evening Transcript* of November 8, a copy of which has been received, that two of its large pages are devoted to particulars and illustrations of the new buildings. Our contemporary speaks with natural pride of the part taken by old students of the institute in making it possible to provide the new buildings. The engineer, the architect, and many other experts engaged upon the work of construction are old students, many of whom are giving their services. To quote from the article:—"Throughout the whole process the institute has been aided by its own best product. For every portion men technically trained in its own departments have come to its aid, and here it should be understood these men are giving liberally what would be exceedingly costly under ordinary commercial rules." Since the fiftieth anniversary of the founding of the institute, in April, 1911, 1,506,000*l.* has been received in gifts, and a considerable part of the money has come from old students.

An examination of the calendar for the current session of the University College of North Wales shows that the Court of Governors spares no pains to keep in close touch with the special needs of the areas from which it more particularly draws its students. As typical of the arrangements made to demonstrate the value of higher educational institutions, it may be stated that the calendar points out that an important new departure has been taken by the authorities of the college in the appointment of two "advisers," who will devote themselves to the investigation of special problems affecting agriculture, and the giving of scientific advice to farmers and others who may refer to them questions for solution. These appointments have been made possible by a special grant made by the Board of Agriculture out of a sum from the Development Fund which has been placed at the disposal of the Board for this particular purpose. In addition to the instruction given in the college itself, a scheme of "out-college agricultural instruction" has been organised, and is now being carried out throughout the greater part of North Wales. This scheme is maintained by means of annual grants, amounting altogether to 1100*l.*, which are voted by the County Councils of Anglesey, Carnarvonshire, Denbighshire, and Flintshire. It is interesting to record that the total sum subscribed for all purposes since the establishment of the college is 230,748*l.*

There is perhaps no more healthy and hopeful sign of the increasing interest in education, whether elementary, secondary, technological, or university, than is to be found in the numerous conferences which are held from time to time by associations of teachers and administrators to discuss questions, not only concerning the administration of education and the relative responsibility of the central and local authorities, but also the subjects most suitable to the various grades of education and the best methods of presenting them. Of these conferences that of the annual congress of the Irish Technical Instruction Association, the report of which has been recently issued, deserves a high place having regard to the interest of the subjects considered and the high quality of the papers read. It is especially gratifying to note that in Ireland, hitherto so much neglected as compared with the rest of the United Kingdom, a vigorous educational life has been awakened as a result of the efforts of enthusiasts like Sir Horace Plunkett, the founder of the Irish Agricultural Organisation Society, to whose zeal and intelligence is also due the establishment of the Department of Agriculture and Technical Instruction, which has done so much through the enlightened and vigorous efforts of its chief officials, Mr. T. P. Gill and Mr. G. Fletcher, to develop technical education in Ireland. The proceedings of this, the twelfth congress, held in May last, under the presidency of Mr. F. C. Forth, the principal of the Belfast Technical Institute, extended over three days, and was attended by representatives from all parts of Ireland, including members of technical instruction committees, principals and teachers of technical schools, members of chambers of commerce, and officials appointed by Government departments. Amongst the important papers read and discussed were:—"Citizenship and Technical Instruction" (a subject almost entirely ignored in schemes of technical instruction), by Mr. T. P. Gill; "Apprenticeship Classes," by Mr. B. O'Shaughnessy; "Technical Instruction: its Achievements and Possibilities," by the Rev. Canon Arthur Ryan; and "Domestic Economy: the Family Budget," by Mr. G. Fletcher. The method of treatment and the importance of the subjects considered give the report a high value, and make it worthy of the serious attention of educationists on this side of the Irish Sea.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 27.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. B. **Hopkinson**: A method of measuring the pressure produced in the detonation of high explosives or by the impact of bullets. A steel shaft about $1\frac{1}{2}$ in. diameter and 4 ft. long is suspended horizontally from strings so that it can swing in a vertical plane as a ballistic pendulum. At one end it carries an end-piece of the same diameter and several inches long. The end-piece is held on by magnetic attraction; the surfaces of the joint are carefully faced. If a bullet be fired at the other end a wave of pressure travels along the shaft, the length of which represents the duration of the blow on the scale 1 in. $= 5 \times 10^{-6}$ second approx. The wave passes the joint without change and is reflected as a tension-wave from the free end. If length of wave exceeds twice that of end-piece, the tail of pressure-wave will have passed the joint when the head of tension-wave reaches it and the piece will fly off, having trapped within it the whole momentum of the blow, leaving the shaft at rest. By experimenting with different lengths of end-piece and finding that which is just long enough to stop the shaft, the duration of blow can be determined. The end-piece is caught in a ballistic pendulum and its momentum measured; thus, knowing the time, the average pressure is determined. Applied to investigation of the blow given by a lead bullet, the method gave results in close accord with those expected on the assumption that the bullet behaves as though it were liquid, the measured duration of blow being nearly that required by the bullet to travel its own length. Measurements by the same method of pressures produced by detonation of a 1-oz. dry guncotton primer showed that, at a distance of $\frac{3}{4}$ in. from surface of cotton, the pressure is practically all gone in 1/50,000 second, the average pressure during that period being about 25 tons per sq. in., and the maximum of the order of 45 tons per sq. in.—J. H. **Jeans**: Gravitational instability and the nebular hypothesis. The work of Maclaurin, Jacobi, Poincaré, and Darwin on rotating fluids has applied only to the abstract case in which the mass is considered perfectly incompressible and homogeneous. To estimate the bearing of their results on astronomical problems, it is important to know to what extent these results remain valid for actual, compressible, heterogeneous masses. The result of the present investigation is summed up concisely by saying that the ideal mass of incompressible fluid has been found to supply a surprisingly good model by which to study the behaviour of the more complicated natural systems considered in astronomy.—B. A. **Keen** and A. W. **Porter**: The diffraction of light by particles comparable with the wave-length. A suspension of finely-divided sulphur, obtained by precipitation from a solution of thiosulphate of soda by the addition of acid, ordinarily diffracts an excess of blue light, so that a white source of light seen through it looks red. One of the authors discovered that if the particles be allowed to grow the red image gradually changes over in colour, becoming at one stage a deep indigo blue, and afterwards passing through various shades of green to white. The present investigation was undertaken to obtain quantitative information in regard to this phenomenon.—Prof. R. J. **Strutt**: Note on the colour of zircons, and its radio-active origin.—Prof. W. H. **Bragg**: The influence of the constituents of the crystal on the form of the spectrum in the X-ray spectrometer. The energy of the pencil of X-rays which falls on the crystal of the X-ray spectrometer is in part spent within the crystal through absorption, which implies the production of kathode and characteristic X-rays, and in part is scattered, producing the reflected ray when circumstances are favourable. It is found that where there is much absorption there is little reflection. The best reflectors are therefore those crystals of which the absorption coefficients are smallest in comparison with their weights or their scattering powers. For this reason alone the diamond must be a very good reflector.—W. L. **Bragg**: The analysis of crystals by the X-ray spectrometer. By a quantitative comparison of the intensities of the successive orders of reflection by various crystal faces, it is shown that the X-ray spectrometer can be made to give a very complete analysis of the crystal structure. The structures particularly investigated in the paper are those of the isomorphous sulphides, pyrites, and hauerite, and of the series of compounds which compose the calcite family of minerals. By a study of these last compounds, it is concluded that the diffracting power of an atom is proportional to its atomic weight.—Dr. T. H. **Havelock**: Ship resistance: the wave-making properties of certain travelling pressure disturbances. The paper contains a theoretical comparison of the wave-making resistance associated with certain distributions of surface pressure. Various inferences are drawn in regard to variation of resistance with speed, and the speeds at which typical interference effects occur. In particular, types are examined which are similar in general form to those associated with the motion of ship models in recent work at the William Froude tank in the National Physical Laboratory.—Dr. R. A. **Houstoun**: The mathematical representation of a light pulse. The object of this paper is to direct attention to a new series of expressions representing the initial form and dispersion of a light pulse. They have been suggested by one of Kelvin's hydrodynamical papers, and are derived from his instantaneous-plane-source solution in the conduction of heat.

Zoological Society, November 11.—Dr. S. F. Harmer, F.R.S., in the chair.—Dr. W. T. **Calman**: Freshwater Decapod Crustacea (families Potamonidæ and Palæmonidæ) collected in Madagascar by the Hon. Paul A. Methuen. One new species of Potamon and five varietal forms of *P. madagascariense* were described. It is suggested that the river-crabs of Madagascar may have had an autochthonous origin from some form resembling *P. madagascariense*. No clear affinities can be traced with the Potamonidæ of Africa or of Peninsular India, but it is pointed out that in the present state of knowledge the river-crabs appear to be a hazardous subject for zoogeographical speculation.—G. A. **Boulenger**: A collection of reptiles and Batrachians made by Dr. Spurrell, in the Colombian Choco. The series of specimens was of great interest, and contained several new species.—C. Tate **Regan**: A revision of the Cyprinodont fishes of the subfamily Pœciliinæ. A number of new genera were defined and several new species were described; the structure of the intromittent organ was found to be of great systematic importance.—Prof. W. N. **Parker**: Investigations on a growth of *Spongilla lacustris* in the Cardiff Waterworks system. The author described the methods adopted to eradicate the sponge from the infected areas.—Prof. J. Playfair **McMurrich**: Two new species of Actinians from the coast of British Columbia. These specimens probably represented stages of a single species, and belonged to a group hitherto not recorded from the west coast of America.

PARIS.

Academy of Sciences, November 24.—M. F. Guyon in the chair.—A. **Haller**: The alkylation of thujone and *iso*thujone by means of sodium amide. An account of the preparation of dimethyl-, diallyl-, and triallylthujone, and of dimethyl*iso*thujone and allyl-*iso*thujone.—A. **Müntz** and H. **Gaudechon**: Contribution to the study of clays. Experiments on the sedimentation of clays under the action of gravity alone, or the combined action of gravity and an electric field. —Edmond **Perrier**: The international protection of nature. On the initiative of M. Paul Sarrasin and the Swiss Government a conference was held at Berne at which it was decided to form a permanent commission to deal with the question of the preservation of rare animals and birds. A. **Verschaffel**: Remarks on the communication of A. Claude and L. Driencourt concerning a new impersonal coincidence micrometer.—A. **Guntz** and A. A. **Guntz, Jr.**: The hydrates of silver fluoride. Details of the conditions necessary for the isolation of the three hydrates, $AgF,4H_2O$, $AgF,2H_2O$, and AgF,H_2O.—A. **Calmette** and V. **Grysez**: Experimental demonstration of the existence of a generalised lymphatic stage, preceding localisations, in tuberculous infections. It is shown that no local lesion is produced at the point of penetration of the bacillus.—Michel **Petrovitch**: The minimum modulus of an analytical function along a circumference.—G. **Kœnigs**: Doubly decomposable movements and surfaces which are the seat of two families of equal curves.—R. **Fortrat**: Groups of real and apparent lines in band spectra.—L. **Margaillan**: The neutralisation of chromic acid. The neutralisation of chromic acid has been studied by means of the hydrogen electrode. The curve of electromotive force shows two points of inflection corresponding to the change of colour of methyl orange and phenolphthalein respectively.—Lucien **Daniel**: A new graft hybrid.—Robert **Douin**: The arrangements for the absorption of water in the female capitule and male disc of the Marchantiaceæ.—A. **Guilliermond**: New cytological researches on the formation of anthocyanic pigments. These pigments and the colourless phenolic compounds are always the product of the activity of the mitochondria.—Raoul **Combes**: The experimental production of an anthocyanine identical with that formed in red leaves in autumn, starting with a compound extracted from green leaves. The red compound was shown to be identical with the colouring matter extracted from red leaves. Contrary to the views currently held, it is a reduction, and not an oxidation product.—P. **Nottin**: The influence of mercury on alcoholic fermentation.—F. **Bordas**: The transmission of typhoid fever by the air. Remarks confirming the conclusions drawn in a recent paper by A. Trillat and M. Fouassier.—Ch. **Nicolle** and L. **Blaizot**: Stable and atoxic antigonococcus vaccines.—MM. **Variot** and **Lavialle**: The effects of sweetened milk in the treatment of dyspeptics with gastric intolerance. The special eupeptic properties of sweetened milk appear to be entirely due to the high proportion of cane sugar.—J. **Bergonié**: Posology in physiotherapy.—Ch. **Gravier**: Some results of the second French Antarctic Expedition: Alcyonaria.—R. **Anthony** and L. **Gain**: The development of pterylosis in the penguin.—M. **Fauré-Fremiet**: *Erythropsis agilis*.—J. **Wolff**: The influence of iron in the development of barley and the specific nature of its action. Neither nickel nor chromium can replace iron in the development of barley.—Em. **Bourquelot** and M. **Bridel**: The biochemical synthesis of the glucosides of polyvalent alcohols: the α-glucosides of glycerol and glycol.—Arthur L. **Day** and E. S. **Shepherd**: Conclusions to be drawn from the analysis of the gases from the crater of Kilauea. The gases are undergoing chemical interaction as they rise in the crater, with marked development of heat. Water vapour is present in large quantity, and chlorine in a negligible proportion only. The nitrogen collected contained no argon.—Remarks by A. **Lacroix** and A. **Gautier** on the preceding paper.—Ph. **Glangeaud**: The characteristics of the spring waters in the volcanic formations of Auvergne.—Ph. **Négris**: The discovery of the Eocene above the Cristallophyllian of the Cyclades and the genesis of the Cristallophyllian facies in Greece.—G. **Valsan**: The evolution of the Roumanian plain between the rivers Olt and Arges.

BOOKS RECEIVED.

Outlines of Chordate Development. By Prof. W. E. Kellicott. Pp. v+471. (New York: H. Holt and Co.) 2.50 dollars.

Das Mittelmeergebiet: seine Geographische und Kulturelle Eigenart. By A. Philippson. Dritte Auflage. Pp. x+256+15 plates. (Leipzig and Berlin: B. G. Teubner.) 6 marks.

The Indian Forest Memoirs. Economy Series. Vol. ii., part ii. On the Economic Value of *Shorea robusta* (Sal.). By R. S. Pearson. Pp. vi+70+viii plates. (Calcutta: Superintendent, Government Printing, India.) 3*s*.

Einführung in die Vererbungswissenschaft. By Prof. R. Goldschmidt. Zweite Auflage. Pp. xii+546. (Leipzig and Berlin: W. Engelmann.) 13 marks.

The Scientists' Reference Book and Diary, 1914. (Manchester: J. Woolley, Sons and Co., Ltd.) 2*s*.

Practical Cinematography and its Applications. By F. A. Talbot. Pp. xii+262+plates. (London: W. Heinemann.) 3*s*. 6*d*. net.

The Diseases of Tropical Plants. By Prof. M. T. Cook. Pp. xi+317. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Alternating Currents and Alternating Current Machinery. By Prof. D. C. Jackson and Dr. J. P. Jackson. New edition. Pp. viii+968. (London: Macmillan and Co., Ltd.) 23*s*. net.

Viśvakarma: Examples of Indian Architecture, Sculpture, Painting, Handicraft. Chosen by Dr. A. K. Coomaraswamy. Part vi., 12 plates. (London: Luzac and Co.) 2*s*. 6*d*.

Influenza: Its History, Nature, Cause, and Treatment. By Dr. A. F. Hopkirk. Pp. xix+209. (London and Felling-on-Tyne: The Walter Scott Publishing Co., Ltd.) 3*s*. 6*d*.

Modern Rationalism as Seen at Work in its Biographies. By Canon H. Lewis. Pp. ix+418. (London: S.P.C.K.) 4*s*. net.

Butterflies and Moths in Romance and Reality. By W. F. Kirby. Pp. 178+28 plates. (London: S.P.C.K.) 5*s*. net.

Canada. Department of Mines. Geological Survey Branch. Memoir No. 37. Portions of Atlin District, British Columbia, with Special Reference to Lode Mining. By D. D. Cairnes. Pp. ix+129+xxxii plates. (Ottawa: Government Printing Bureau.)

Handbuch der Hygiene. Edited by Profs. M. Rubner, M. v. Gruber, and M. Ficker. III. Band, 3 Abteilung. Die Infektionskrankheiten. Pp. iv+392+xxxii plates. (Leipzig: S. Hirzel.) 24 marks.

Die Anatomie des Menschen. Teil. v. Nervensystem und Sinnesorgane. By Prof. K. von Bardeleben. Pp. 82. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland, 1913. Pp. vi+380. (London: C. Griffin and Co., Ltd.) 7s. 6d.

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part xi. (London: W. Wesley and Son.) 3s. 6d. net.

"Squaring the Circle": a History of the Problem. By Prof. E. W. Hobson. Pp. 57. (Cambridge University Press.) 3s. net.

Educational School Gardening and Handwork. By G. W. S. Brewer. Pp. xi+192. (Cambridge University Press.) 2s. 6d. net.

Les Problèmes de la Sexualité. By Prof. M. Caullery. Pp. 332. (Paris: E. Flammarion.) 3.50 francs.

Soils and Crops, with Soils Treated in Reference to Crop Production. By Profs. T. F. Hunt and C. W. Burkett. Pp. xiii+541. (New York: Orange Judd Company; London: Kegan Paul and Co., Ltd.)

Department of Commerce. Technologic Papers of the Bureau of Standards. No. 16, Manufacture of Lime. By W. E. Emley. Pp. 130+plates. (Washington: Government Printing Office.)

Survey of India. Professional Paper No. 14, Formulæ for Atmospheric Refraction and their Application to Terrestrial Refraction and Geodesy. By J. de G. Hunter. Pp. v+114. (Dehra Dun: Office of the Trigonometrical Survey.)

Mitteilungen der Prähistorischen Kommission der K. Akademie der Wissenschaften. II. Band., No. 2, 1912. Pp. 127–227. (Vienna: A. Hölder.)

City and Guilds of London Institute. Department of Technology, Exhibition Road, London, S.W. Report of the Department for the Session 1912–13. Pp. x+467. (London: J. Murray.)

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 4.

ROYAL SOCIETY, at 4.30.—(1) A Method of Studying Transpiration; (2) The Effect of Light on the Transpiration of Leaves: Sir Francis Darwin.—Dimensions of Chromosomes considered in Relation to Phylogeny: Prof. J. B. Farmer and L. Digby.—The Process of Calcification in Enamel and Dentine: J. H. Mummery.—The Optimum Temperature of Salicin Hydrolysis by Enzyme Action is Independent of the Concentrations of Substrate and Enzyme: A. Compton.—The Ratio between Spindle Lengths in the Spermatocyte Metaphases of Helix Pomatia: C. F. U. Meek.—Egyptian Blue: Dr. A. P. Laurie, W. F. P. McLintock and F. D. Miles.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electricity Supply in Large Cities: Dr. G. Klingenberg.

LINNEAN SOCIETY, at 8.—Wild Wheat from Mount Hermon, *Triticum dicoccoides* Koern: Prof. J. Percival.—Neurotes, a New Genus of Mymaridæ, from Hastings: F. Enock.—A Contribution to the Study of the Evolution of the Flower; with Special Reference to the Hamamelidaceæ, Caprifoliaceæ and Cornaceæ: A. S. Horne.—The Mollusca of the River Nile: Mrs. Longstaff.

FRIDAY, DECEMBER 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Thomas Hawksley Lecture: Water as a Mechanical Agent: E. B. Ellington.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Presidential Address: Sir Boverton Redwood, Bart.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Liverpool Street Extension of the Central London Railway: H. V. Hutt.

GEOLOGISTS' ASSOCIATION, at 8.—Evolution and Palæobotany: Dr. Marie C. Stopes.

MONDAY, DECEMBER 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Is the Earth Drying Up?: Prof. J. W. Gregory.

ROYAL SOCIETY OF ARTS, at 8.—The Measurement of Stresses in Materials and Structures: Prof. E. G. Coker.

TUESDAY, DECEMBER 9.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Transandine Railway: B. H. Henderson.—*Probable Paper*: Cyclical Changes of Temperature in a Gas-engine Cylinder: Prof. E. G. Coker and W. A. Scoble.

WEDNESDAY, DECEMBER 10.

ROYAL SOCIETY OF ARTS, at 8.—The application of Electricity to Agriculture and Life: T. Thorne Baker.

THURSDAY, DECEMBER 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Intermittent Vision: A. Mallock.—The Relations between the Crystal-symmetry of the Simpler Organic Compounds and their Molecular Constitution. III.: W. Wahl.—The Selective Absorption of Ketones: Prof. G. G. Henderson and J. M. Heilbron.—Absolute Measurements of a Resistance by a Method based on that of Lorenz: F. E. Smith.—A Determination of the Electromotive Force of the Weston Normal Cell in Semi-absolute Volts. (With a Preface by Prof. H. L. Callender, F.R.S.): A. N. Shaw.—Elastic Hysteresis in Steel: F. E. Rowett.—A Simple Form of Micro-balance for Determining the Densities of Small Quantities of Gases: F. W. Aston.—A Second Spectrum of Neon: T. R. Merton.

MATHEMATICAL SOCIETY, at 5.30.—The Linear Integral Equation: Prof. E. W. Hobson.—Generalised Hermite Functions and their Connection with the Bessel Functions: H. E. J. Curzon.—Limiting Forms of Long Period Tides: J. Proudman.—The Number of Primes of Same Residuacity: Lieut.-Col. Cunningham.—Some Results on the Form Near Infinity of Real Continuous Solutions of a Certain Type of Second Order Differential Equations: R. H. Fowler.—The Potential of a Homogeneous Convex Body and the Direct Integration of the Potential of an Ellipsoid: S. Brodetsky.—The Dynamical Theory of the Tides in a Polar Basin: G. R. Goldsbrough.—Proof of the Complementary Theorem: Prof. J. C. Fields.

CONCRETE INSTITUTE, at 7.30.—Some Fallacies in Testing Cement: L. Gadd.

ROYAL SOCIETY OF ARTS, at 4.30.—The Cultivation and Manufacture of Indian Indigo: Prof W. P. Bloxam.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Continuation of Discussion on Dr. Klingenberg's Address on "Electricity Supply in Large Cities."

FRIDAY, DECEMBER 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—

MALACOLOGICAL SOCIETY, at 8.—Descriptions of Various New Species of Mollusca: G. B. Sowerby.—Synonymy of the Family Veneridæ: A. J. Jukes-Browne, F.R.S.—Descriptions of New Species of Land and Marine Shells from the Montebello Islands, Western Australia: H. B. Preston.

ALCHEMICAL SOCIETY, at 8.15.—Alchemy in China: Prof. H. Chatley.

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Professor H. H. TURNER, F.R.S.—Course of Six Lectures on "A VOYAGE IN SPACE: THE STARTING POINT—OUR EARTH; THE START THROUGH THE AIR; JOURNEYING BY TELESCOPE; VISITS TO THE MOON AND PLANETS; OUR SUN; THE STARS." On December 27 (Saturday), December 30 (Tuesday), January 1 (Thursday), January 3 (Saturday), January 6 (Tuesday), January 8 (Thursday), at Three o'clock.

COURSES OF LECTURES.

Professor WILLIAM BATESON, F.R.S.—Six Lectures on "ANIMALS AND PLANTS UNDER DOMESTICATION." On Tuesdays, January 20, 27, February 3, 10, 17, 24, at Three o'clock.

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ARTHUR H. SMITH, Esq., F.S.A Two Lectures on "LANDSCAPE AND NATURAL OBJECTS IN CLASSICAL ART." On Tuesdays, March 24, 31, at Three o'clock.

WILLIAM McDOUGALL, Esq., F.R.S. Two Lectures on "THE MIND OF SAVAGE MAN" (Illustrated by the Pagan Tribes of Borneo). On Thursdays, January 22, 29, at Three o'clock.

Professor SIR THOMAS H. HOLLAND, K.C.I.E., F.R.S. Two Lectures on "TYPES AND CAUSES OF EARTH CRUST FOLDS." On Thursdays, February 5, 12, at Three o'clock.

Professor I. GOLLANCZ, F.B.A. Two Lectures on "HAMLET IN LEGEND AND DRAMA." On Thursdays, February 19, 26, at Three o'clock.

Professor C. T. JENKIN, M.Inst.C.E. Three Lectures on "HEAT AND COLD." On Thursdays, March 5, 12, 19, at Three o'clock.

CALEB WILLIAMS SALEEBY, Esq., M.D. Two Lectures on "THE PROGRESS OF EUGENICS." On Thursdays, March 26, April 2, at Three o'clock.

Professor FREDERICK CORDER. Three Lectures on "NEGLECTED MUSICAL COMPOSERS" (with Musical Illustrations). On Saturdays, January 24, 31, February 7, at Three o'clock.

JOHN ALLEN HARKER, Esq., F.R.S.—Two Lectures on "THE ELECTRIC EMISSIVITY OF MATTER" (with Experimental Illustrations). On Saturdays, February 14, 21, at Three o'clock.

Professor SIR J. J. THOMSON, O.M., F.R.S. Six Lectures on "RECENT DISCOVERIES IN PHYSICAL SCIENCE" On Saturdays, February 28, March 7, 14, 21, 28, April 4, at Three o'clock.

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The FRIDAY EVENING MEETINGS will begin on January 23, at 9 p.m., when Professor SIR JAMES DEWAR will give a Discourse on THE COMING OF AGE OF THE "VACUUM FLASK." Succeeding Discourses will probably be given by Mr. H. WICKHAM STEED, Dr. H. S. HELE-SHAW, Professor J. NORMAN COLLIE, Professor ARTHUR KEITH, Professor W. A. BONE, The Rev. Canon J. O. HANNAY, ("GEORGE BIRMINGHAM"), Sir WALTER R. LAWRENCE, Bart., The Right Hon. Lord RAYLEIGH, O.M., Professor J. A. FLEMING, Professor Sir J. J. THOMSON, O.M., and other gentlemen.

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THURSDAY, DECEMBER 11, 1913.

THE NEW PHYSICAL CHEMISTRY.

Physikalische Chemie der homogenen und heterogenen Gasreaktionen. By Dr. Karl Jellinek. Pp. xiv+844. (Leipzig: S. Hirzel, 1913.) Price 30 marks.

THIS stout volume witnesses in a remarkable manner to certain recent developments in physical chemistry—developments which bid fair to mark the opening of a period of fundamental and fruitful research, comparable in importance only with the years following the enunciation of the laws of solution and of electrolytic dissociation. We refer, of course, to the third principle of thermodynamics due to Nernst, and to the theory of energy quanta, first deduced by Planck as an integral part of his radiation theory, and then later applied with great success by Einstein, Nernst, and Lindemann to the development of a theory of specific heats. The Nernst principle and the Planck theory are closely connected by the Boltzmann conception of entropy as a statistical and probability magnitude, and the changes which their introduction has already brought about in physical chemistry can be well appreciated by comparing Haber's "Thermodynamik technischer Gasreaktionen" (published in 1905) with the present book, which has been essentially written from the point of view of these new theories. The possibility of the prediction of the course and extent of a chemical reaction from purely thermal data, combined with a knowledge of certain physical constants, is now well within reach.

Dr. Jellinek has not himself been directly concerned in any of the advances with which he chiefly deals. He is, however, favourably known both as a former pupil of Nernst's, and as the author of some recently published elaborate and excellent physico-chemical investigations on hyposulphites. And although this volume contains no original work, it nevertheless deserves much praise as a very good exposition of the subject with which it deals.

We have, at the outset, a discussion of the first and second laws of thermodynamics. Gaseous equilibria are then carefully treated, using reversible cycles, as well as entropy and the thermodynamic potential functions. The Nernst theorem is introduced in connection with the indeterminate constants occurring in the integrated form of the reaction isochore equation, and also, again, in connection with the entropy conception. A consideration of entropy and the second law from the statistical point of view follows. Then comes a detailed treatment of the theory of radiation, culminating in a discussion of Planck's formula, and of the properties of his oscillators and resonators.

The next very interesting section contains much material previously unavailable in book form. It expounds a theory of specific heats founded on the assumption that molecules can be regarded as oscillating systems of definite frequencies, similar in properties to Planck's oscillators, and that their energy content can only change by means of definite energy quanta or units. The methods (compressibility, melting point, abnormal dispersion, selective emission, absorption and reflection, photo-electric effect) by which these frequencies can be determined are reviewed, and the excellent agreement between specific heats calculated on this basis and the experimental values shown. Other applications of the theory of quanta are considered (*e.g.*, that by Haber to the heat effect of a chemical reaction), and the section closes with an excellent discussion—in a sense the keystone of the whole book—of the close connection between the Nernst theorem and the theory of quanta. The name of Sackur is here prominent.

The author then deals with the experimental side of the foregoing subjects. The technique of radiation measurements (more particularly in the infra-red region) is described, and we are given reviews of the methods used for specific heat determinations (several of them, *e.g.*, the beautiful explosion method of Pier, developed in Nernst's laboratory) and for the investigation of gaseous equilibria. The section dealing with the kinetics of the subject is short, and, with the exception of the reaction-velocity theories of Krüger and of Trautz, contains little new. Finally come two brief but interesting sections dealing with the electrochemistry and photochemistry of gas reactions, in which the views and researches of Krüger, Haber, Warburg, Einstein, and others find a place.

The book is written with great enthusiasm, and the author is obviously well acquainted with the literature of his subject. Everything is admirably knit together and co-ordinated, and the latest publications are noted and given their place in the general scheme. The only criticism we feel inclined to make concerns, not the manner in which the author has done his work, but the advisability of doing it at all in the form he has chosen. His volume contains material for at least four or five books. Two of these have already been written by Planck and one by Haber, whilst his most interesting chapters deal with a subject at present in a state of very rapid development—a subject, moreover, on which we may perhaps shortly expect an authoritative pronouncement from Nernst himself. The author has further, from want of space, been sometimes compelled to omit or skim over certain points in a very arbitrary fashion, at the same time using material which plainly interests him, but is less germane to the matter in hand. This is distinctly a fault in so all-comprehensive a book, and indicates that a more modest programme would have been better. There is no doubt, however, that he has essentially succeeded in giving unity to the subjects treated, and his volume, with the above qualifications, is strongly to be recommended. As to the wisdom of the choice of his particular point of view, there can be little doubt. Haber has been credited with the remark that the basis of physical chemistry in the future will be one part thermodynamics and three parts theories of radiation and quanta. And when one considers the manifold ways in which these theories have already been applied—to specific heats, photo-electric effect, Röntgen rays, γ-rays, radioactive changes, the emission of free electrons during chemical changes, thermoelectromotive force, electrical resistance, &c.—one will not feel inclined to dispute his prophecy. The growing importance of atomic and molecular mechanics in comparison with classical thermodynamics is undoubtedly the outstanding feature of physical chemistry at the present moment.

VETERINARY PHYSIOLOGY.

A Manual of Veterinary Physiology. Fourth edition. By Major-General F. Smith, C.B., C.M.G. Pp. xii + 808; 259 illustrations. (London: Baillière, Tindall and Cox, 1912.) Price 18*s*. net.

AS pointed out by the author, this work is essentially a veterinary, and not a comparative, physiology, and an endeavour has been made to render it of service, not only to the student of theoretical veterinary physiology, but also to the clinician. Throughout the book the author has taken every opportunity of pointing out the clinical application of various physiological facts, and further indicating how various pathological conditions are purely derangements of physiological conditions.

The work as a whole is excellent, and this edition must rank as the standard text-book on the subject in English. If any sections of the book stand out from the others, they are probably those on "locomotion" and on "the foot." The chapter on the former is really a masterly exposition of the subject; all paces are carefully considered, and the text is made very easy to follow by means of several series of excellent notations. There is also a very interesting discussion on the influence of age on the capacity for work, and attention is directed to the apparent considerable difference between man and the horse in this respect.

There are some features, however, which call for criticism. On referring to the paragraph on blood platelets, the author says: "It is probable they are distinct elements." Other authorities, however, do not agree with this view, Buckmaster and others going so far as to state that there are no blood platelets in circulating blood. The question is dismissed too shortly in one small paragraph. On p. 152 the author refers to "broken-wind" in horses, and after admitting that the condition is one in which the lungs lose their power of elastic recoil, he states that "one of the fundamental errors in veterinary pathology is to attribute this condition to emphysema or asthma." Here we join issue with the author, and while agreeing that the condition is not asthma, would point out to him that a suitably prepared section of the lung of a broken-winded horse shows quite clearly that the loss of elastic recoil in a chronic case is due to the rupture of the vesicular walls, and is, in fact, "chronic vesicular emphysema."

A list of *corrigenda* has been inserted at the front of the book, but one mis-spelt word has been overlooked on p. 192, "attendi*hg*" appearing for "attending." There is also an exhaustive index and a list of authorities quoted in the text. The printing and binding and general make-up of the book are in Messrs. Baillière's usual good style.

POPULAR ASTRONOMY.

Astronomy. By G. F. Chambers. Pp. xxiv + 335 + cxxxv plates. (London: Hutchinson and Co., n.d.) Price 5*s*. net.

Daytime and Evening Exercises in Astronomy. For Schools and Colleges. By Dr. Sarah F. Whiting. Pp. xv + 104. (Boston and London: Ginn and Co., n.d.) Price 3*s*. 6*d*.

The Ways of the Planets. By M. E. Martin. Pp. v + 273 + vi plates. (New York and London: Harper and Brothers, 1912.) Price 5*s*. net.

(1) IN this volume Mr. Chambers has aimed at giving the man of ordinary education—too often, alas, deficient of any precise ideas regarding the fundamental truths of the oldest of the sciences—a clear and simple insight into the astronomy of to-day; and he has accomplished his part of the task with characteristic success. Abstruse problems are not sprung upon the young astronomer, nor are they obviously evaded, but at all times is he encouraged to observe phenomena for himself, and thereby to grasp more thoroughly

the lucid explanations. Sun, moon, and planets; tides, time, and eclipses; meteors and comets, and then the constellations, stars, and nebulæ, with their spectroscopic characteristics, are all dealt with in turn. Nor is the practically-minded neophyte neglected, for he will find some useful hints as to how to obtain and house his instrument, with some idea of the probable cost, based on actual accomplishments. The beginner should find little to confuse, and much that will enlighten him, although in the very brief survey of astro-spectroscopy he may wonder what such terms as "minimum-deviation" (p. 303) mean, and it is to be hoped that he will proceed to make further inquiries into this most fascinating branch of the subject. The book is very well and profusely illustrated, some of the plates being in colour, and can be recommended as an excellent work for the serious beginner. In the copy under review the transposition of the top line on p. 24 to the top of p. 25 makes the text much simpler.

(2) While Mr. Chambers aims at curing ignorance, Dr. Whiting seeks to prevent it, and to this end has compiled a set of educative, practical exercises in astronomy. The general aim of the author has been to formulate a set of exercises, *e.g.*, the use of globes, plate-measuring, spectrum observing and plotting, the plotting of ephemerides, sunspot numbers, &c., such as could be performed in day-classes independently of local weather conditions. In the hands of an enthusiastic and imaginative teacher we can conceive that the book would be extremely useful, but we fear that in the hands of the ordinary student the exercises might easily tend to become more automatic than is desirable. Such an aim necessarily restricts the scope of the work it is possible to do, but in places, for example, in the exercise on spectroscopic work, we feel that the author has missed many opportunities where actual manipulation on the part of the student would add exceedingly to the interest and the educative influence of the work. Our experience with students is that the reduction of a spectrum taken by themselves is likely to awake far wider interests than is the copying, even in colour, of a chart from some text-book. The mere statement of "principles" relating to such matters as velocity- and pressure-shifts, and the action of a magnetic field on radiations, savours of "cram," and should, we think, find no place in such a book.

(3) This is a charming book, telling the novice all that it is necessary for him to know, first about the planets in general and then in particular, and telling him in such language that he should never have to pause for a single definition or explanation that is not in the text. For each planet the family features are compared or contrasted, the physical condition explained, with the points where definite explanation is not yet forthcoming set out in clear and moderate language, and the ephemeris for a number of the coming years is very carefully interpreted; thus we find that on August 5, 1914, Mercury will be at western elongation, and "favourable for viewing," while we shall have "splendidly brilliant oppositions" of Mars in July, 1939, and early October, 1941, respectively. The author makes one feel at home with the planets by giving a very full introduction to every member of the solar family, and where figures are necessary, she robs them of all their awe by her familiar and easily-employed standards, leaving the reader of ordinary intelligence with a very fair idea of their significance. There is some repetition of facts in the book, but the forms in which they are stated are ever new and always interesting. Such a book, for its fund of information, its ease of comprehension, and its delightful style, should be found in every school library and (astronomically) youthful circle.

William E. Rolston.

OUR BOOKSHELF.

Flies in Relation to Disease. Non-Bloodsucking Flies. By Dr. G. S. Graham-Smith. Pp. xiv + 292 + xxiv plates. (Cambridge: University Press, 1913.) Price 10*s.* 6*d.* net.

This is just the book for students who either are, or are to be, occupied with questions of public health; it is careful, well-digested, precise, and clear. Dr. Graham-Smith has practical knowledge of the things that he writes about, having already published numerous experiments on the transmission of bacteria by flies. His book is freely illustrated by excellent plates and text-figures by Mr. Edwin Wilson.

The evidence which convicts the common house-fly of causing heavy mortality in military camps seems to be complete; the same insect is also strongly suspected of being a chief agent in spreading typhoid, summer-diarrhœa, and other infectious diseases of cities. Visible proofs are here given that house-flies deposit vomit or fæces wherever they settle, and this of itself shows how dangerous they may be when any disease propagated by microbes is prevalent. It is to be hoped that the disgust which chapter vii., on the habits of flies, is sure to excite may rouse our sanitary authorities to root-out the breeding-places of the "busy, curious, thirsty fly," which is at present treated with far too much indulgence. Dr. Graham-Smith's facts, handled by a newspaper writer not unversed in biological studies, might furnish telling articles, such as rendered good service in the campaign against *malarial* insect-infection, and in America (not as yet in England) against *bacterial* insect-infection as well. We hope to see them deeply impressed on the public mind.

The instructive descriptions before us are accompanied by excellent figures; nevertheless we have a suggestion to make about the determination of the house-flies. Dr. Graham-Smith has eighteen species of house-frequenting Diptera to deal with (p. 15). Most of them present no serious difficulty, but students unpractised in entomology will find a few hard to distinguish. Would it not be well to lighten their labours by a discrimination-table, which would concentrate attention upon the decisive characters? A single character (*e.g.* the tubercle on the middle tibia of *Fannia scalaris*), is sometimes a certain mark of the species. Or the really decisive characters might be italicised. The student should afterwards compare his fly with the description in every point; identification is not the only purpose of descriptions.

Non-piercing strikes us as a neater phrase than *non-bloodsucking*.

The Ideals and Organisation of a Medical Society. By Dr. J. B. Hurry. Pp. 51. (London: J. and A. Churchill, 1913.) Price 2*s*. net.

THE name of Reading, at the present moment, is mostly associated with political excitement; but Reading has many interests, and, among them, it is the home of one of the best of all the provincial medical societies. Dr. Hurry has done well to write an account of the work, purposes, and constitution of a medical society. He is a good friend to Reading; he loves its history, its old buildings; he has made many gifts to the town; he has been, for years, its chief chronicler; and the Reading Pathological Society is an example of all that a medical society ought to be. Indeed, a good medical society is a very great help to a town. It raises the level of things; it promotes the spirit of science; it ensures the efficiency of the town's hospital; it is a bond of union among practitioners; it adds dignity, distinction, and modernity to their art, and friendship and ambition. The interchange of knowledge, the comparison of experiences, the criticism, the honourable competition, all tend to achievement. Of course, there are difficulties; the hard-worked doctor cannot easily find time to attend meetings or to prepare papers. Waste of time, repetition, overlapping of subjects, are to be avoided, but are not always easy of avoidance. But a good medical society, such as the Reading Pathological Society, is an excellent help to men in practice, and to the town in which they practise.

A Day in the Moon. By the Abbé Th. Moreux. Pp. viii+199. (London: Hutchinson and Co., 1913.) Price 3*s*. 6*d*. net.

IN these pages the Abbé Moreux chats on the moon and all that is related to it, and the reader will find not only that the matter is displayed in a very readable form, but that he will have learnt numerous facts, and have had a very instructive lesson, by the time he has finished the volume. A day in the moon refers actually to a lunar day, and the reader is transported to the moon and treated as if he were an inhabitant of that body. The author in this way introduces him to the mountain ranges and craters, and other conspicuous high and low lands which are brought into view as the solar rays illuminate them. Here and there are brought in incidentally interesting side issues, such as the probable use of lenses before ever Galileo or the inventor, a certain Dutchman, came to re-invent and use them. Bringing the reader back to earth again, he introduces him to such themes as the tides, possible weather changes due to the moon, action of the moon on vegetation and organic life, and on men and animals, and finally concludes with a list of objects shown on a map of the moon, those to be studied on each day of a lunation, and the lunar elements. Numerous illustrations from photographs and the author's drawings accompany the text. The translator has done his work well, and has, in the form of footnotes, made many statements more clear to British readers, such as when references were made to the metric system of measurements, and to distances between French towns.

Recent Physical Research. An Account of some Recent Contributions to Experimental Physics. By D. Owen. Pp. iii+156. (London: *The Electrician* Printing and Publishing Co., Ltd., n.d.) Price 3*s*. 6*d*. net.

A PUBLICATION dealing with some of the most important recent developments of physics is sure to be of use if written with sufficient knowledge and a pleasing style. This book has both those advantages. The subjects include positive rays (with Thomson's new method of chemical analysis), the magnetic work of Curie, Weiss, and Heusler, new theories of the aurora (Störmer and Birkeland), Brownian movements (Einstein and Perrin), the pressure of light, the narrowing gap between the longest heat-waves and the shortest electromagnetic waves (Rubens, Lebedef), and the application of the electron theory to metallic conduction. The blocks are particularly good. One could wish for rather fuller references, and for a fuller treatment of the modern radiation problem (on p. 106 Planck's and Wien's formulæ are presented without directing attention to the importance of the "action constant"). But in view of the limited space at the author's disposal, a large amount of new information is attractively displayed.

Lip-reading: Principles and Practice. A Handbook for Teachers and for Self-instruction. By Edward B. Nitchie. Pp. xiv+324. (London: Methuen and Co., Ltd., n.d.) Price 5*s*. net.

THE hard-of-hearing will be able to study lip-reading from this book without the aid of a teacher, if such a course is found necessary. The book is arranged also for use, under a teacher's guidance, by the semi-mute and the congenitally deaf who have acquired speech and language. The first part of the book is explanatory and directive, and the second gives exercises for practice.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Structure of the Atom.

In a letter to this journal last week, Mr. Soddy has discussed the bearing of my theory of the nucleus atom on radio-active phenomena, and seems to be under the impression that I hold the view that the nucleus must consist entirely of positive electricity. As a matter of fact, I have not discussed in any detail the question of the constitution of the nucleus beyond the statement that it must have a resultant positive charge. There appears to me no doubt that the α particle does arise from the nucleus, and I have thought for some time that the evidence points to the conclusion that the β particle has a similar origin. This point has been discussed in some detail in a recent paper by Bohr (*Phil. Mag.*, September, 1913). The strongest evidence in support of this view is, to my mind, (1) that the β ray, like the α ray, transformations are independent of physical and chemical conditions, and (2) that the energy emitted in the form of β and γ rays by the transformation of an atom of radium C is much greater than could be expected to be stored up in the external electronic system. At the same time, I think it very likely that a considerable fraction of the β rays which are expelled from radioactive substances arise from the external electrons. This, however, is probably a secondary effect resulting from the primary expulsion of a β particle from the nucleus.

The original suggestion of van der Broek that the charge on the nucleus is equal to the atomic number and not to half the atomic weight seems to me very promising. This idea has already been used by Bohr in his theory of the constitution of atoms. The strongest and most convincing evidence in support of this hypothesis will be found in a paper by Moseley in *The Philosophical Magazine* of this month. He there shows that the frequency of the X radiations from a number of elements can be simply explained if the number of unit charges on the nucleus is equal to the atomic number. It would appear that the charge on the nucleus is the fundamental constant which determines the physical and chemical properties of the atom, while the atomic weight, although it approximately follows the order of the nucleus charge, is probably a complicated function of the latter depending on the detailed structure of the nucleus.

E. Rutherford.

Manchester, December 6, 1913.

The Reflection of X-Rays.

In view of the great interest of Prof. Bragg's and Messrs. Moseley and Darwin's researches on the distribution of the intensity of the primary radiation from X-ray tubes, it may be of interest to describe an alternate method which I have found very convenient (*Comptes rendus*, November 17, 1913).

As we know, the wave-length of the reflected ray is defined by the equation $n\lambda = 2d \sin\theta$, where n is a whole number, d the distance of two parallel planes, and θ the glancing angle. If one mounts a crystal with one face in the axis of an instrument that turns slowly and regularly, such as, for instance, a registering barometer, the angle changes gradually and continuously.

If, therefore, one lets a pencil of X-rays, emerging from a slit, be reflected from this face on to a photographic plate, one finds the true spectrum of the X-rays on the plate, supposing intensity of the primary beam to have remained constant. (This can be tested by moving another plate slowly before the primary beam during the exposure.)

The spectra thus obtained are exactly analogous to those obtained with a diffraction grating, and remind one strongly of the usual visual spectra containing continuous parts, bands, and lines.

So far I have only identified the doublet, $11^\circ\ 17'$ and $11^\circ\ 38'$, described by Messrs. Moseley and Darwin. The spectra contain also a number of bright lines about two octaves shorter than these, and the continuous spectrum is contained within about the same limits. These numbers may be used in the interpretations of diffraction Röntgen patterns, as they were obtained with tubes of the same hardness as those used for producing these latter.

The arrangement described above enables us to distinguish easily the spectra of different orders, as the interposition of an absorbing layer cuts out the soft rays, but does not weaken appreciably the hard rays of the second and higher orders.

It is convenient also for absorption experiments; thus a piece of platinum foil of 0·2 mm. thickness showed transparent bands. The exact measurements will be published shortly, as well as the result of some experiments I am engaged upon at present upon the effect of changing the temperature of the crystal.

Maurice de Broglie.

29, Rue Chateaubriand, Paris, December 1.

As W. L. Bragg first showed, when a beam of soft X-rays is incident on a cleavage plane of mica, a well-defined proportion of the beam suffers a reflection strictly in accordance with optical laws. In addition to this generally reflected beam, Bragg has shown that for certain angles of incidence, there occurs a kind of selective reflection due to reinforcement between beams incident at these angles on successive parallel layers of atoms.

Experiments I am completing seem to show that a generally reflected beam of rays on incidence at a second crystal surface again suffers optical reflection; but the degree of reflection is dependent on the orientation of this second reflector relative to the first.

The method is a photographic one. The second reflector is mounted on a suitably adapted goniometer, and the photographic plate is mounted immediately behind the crystal. The beam is a pencil 1·5 mm. in diameter. When the two reflectors are parallel the impression on the plate, due to the two reflections, is clear. But as the second reflector is rotated about an axis given by the reflected beam from the first and fixed reflector, the optically reflected radiation from the second reflector—other conditions remaining constant—diminishes very appreciably. As the angle between the reflectors is increased from 0° to 90°, the impression recorded on the photographic plate diminishes in intensity. For an angle of 20° it is still clear; for angles in the neighbourhood of 50° it is not always detectable; and for an angle of 90° it is very rarely detectable in the first stages of developing, and is then so faint that it never appears on the finished print.

These results, then, would show that the generally reflected beam of X-rays is appreciably polarised in a way exactly analogous to that of ordinary light. Owing to the rapidity with which the intensity of the generally reflected beam falls off with the angle of incidence of the primary beam, it has not been possible to work with any definiteness with angles of incidence greater than about 78°, and this is unfortunately a considerably larger angle than the probable polarising angle. Experiments with incidence in the neighbourhood of 45° should prove peculiarly decisive, for whereas ordinary light cannot as a rule be completely polarised by reflection, the reflection of X-rays, which occurs at planes of atoms, is independent of any contamination of the exposed crystal surface, and polarisation, once established, should prove complete for radiation reflected at the polarising angle. The selectively reflected X-rays seem to show the same effects as does the generally reflected beam. Selectively reflected radiation is always detectable after the second reflection, but this seems due to the selectively reflected radiation produced at the second reflector by the unpolarised portion of the beam generally reflected at the first reflector.

The application of a theory of polarisation to explain the above results is interestingly supported by the fact that in the case of two reflections by parallel reflectors, the proportion of X-rays reflected at the second reflector is invariably greater than the proportion of rays reflected at the first; that is, the ratio of reflected radiation to incident radiation at the second reflector is always greater than the same ratio at the first reflector. This might be expected if vibrations perpendicular to the plane of incidence are to be reflected to a greater extent than those in the plane of incidence. The proportion of such vibrations is larger in the beam incident on the second reflector than in the original beam, and a greater proportion of radiation would be reflected at the second reflector than could be at the first. For the case of parallel reflectors and incidence of a primary beam on the first at the polarising angle, the reflection at the second should be complete.

E. JACOT.

South African College, Cape Town,
November 14.

Residual Ionisation in Gases.

FROM observations made by Simpson and Wright, the writer, and others, it is now known that the ionisation in air confined in airtight clean zinc vessels is about 8 or 9 ions per c.c. per second when the observations are made on land where the soil contains only such minute traces of radio-active substances as are found in ordinary clays or loams.

On the other hand, when the observations are made on the ocean or on the surface of large bodies of water, such as Lake Ontario, the ionisation in the same air confined in the manner indicated above drops to about 4 ions per c.c. per second. This reduction in the number of ions per c.c. per second has been shown to be due to the absorption of the earth's penetrating radiation by the water of the ocean and by that of the lakes.

On a recent voyage from England to Canada, I thought it would be interesting to see what the drop in the ionisation would be when the air in a zinc vessel was replaced by hydrogen. The observations were made on the ss. *Megantic*, a vessel of about 14,000 tons burden. On this boat the ionisation in air confined in a Wulf electrometer made of zinc was found to be 4·65 ions per c.c. per second, while in hydrogen it was 1·8 ions per c.c. per second. On reaching Toronto the experiment was repeated in a building which was free from any radio-active impurity, and in this case the ionisation in air was found to be 8·8 ions per c.c. per second, while in hydrogen it was 2·0 ions per c.c. per second.

The ionisation of the air on land was therefore 4·15 ions per c.c. per second more than it was upon the steamship, while the ionisation in hydrogen on the land was only 0·2 ion per c.c. per second more than on the sea. From this it follows that the ionisation produced in air by the penetrating radiation at the surface of the earth at Toronto was about twenty times as much as that produced by the same radiation in hydrogen.

Since the residual ionisation in hydrogen on the ocean was nearly 40 per cent. of that in air, it is evident that the residual ionisation in these two gases could not have been due to a radiation of the type of the earth's penetrating rays. Experiments should therefore be directed to determining whether this residual effect in gases is due to the action of an easily absorbed radiation from the walls of the vessel in which the gases are confined, or whether it has its origin in a disruption of the molecules occurring either spontaneously or through the agency of collisions.

J. C. MCLENNAN.

The Physical Laboratory, University of Toronto,
November 13.

The Nile Flood of 1913.

FOR some years past the Meteorological Office of the Egyptian Survey Department, under the direction of Mr. J. I. Craig, has carried out researches on the question of the possibility of forecasting the Nile flood, and he has put forward the theory that the rain which falls in Abyssinia comes from the South Atlantic (see "England, Abyssinia, the South Atlantic: a Meteorological Triangle," Quarterly Journal Royal Meteorological Society, October).

There is much evidence to support this, and correlations have been established between the flood, and pressure and wind velocity at St. Helena, and pressure in South America. So far the best prediction which can be based on these correlations is for the mean height of the Nile at Halfa, between July 16 and August 15, that is, in normal years for the middle of the rising stage. The probable error of a prediction based on this is ±0·33 metre, whereas a prediction which assumes that the river will be normal in any given year would have a probable error of ±0·55 metre. This result is sufficiently encouraging to make further work promising, and the writer is pursuing the investigation.

The flood of this year has been the lowest of which there is authentic and complete record. Records of the maximum and minimum of the flood as recorded on the Roda Nilometer (Cairo) go back to very early times, but naturally the early ones are less trustworthy than those of more recent date. The following figures, taken from "Egyptian Irrigation," by Sir William Willcocks and Mr. J. I. Craig, give the lowest recorded floods in recent times:—

Period	Lowest maximum recorded on Roda Nilometer Metres	No. of years of period recorded
1701–1725	17·35	18
1726–1750	18·58	24
1751–1775	18·08	25
1776–1800	15·49 (1)	
1801–1825	13·14 (2)	3
1826–1850	18·15	25
1851–1875	18·30	25
1876–1900	17·65	25
1901–1913	17·17 (1913)	13

(2) Is almost certainly an error of 10 pics. (the divisions on the gauge), and it seems very probable that (1) is also an error, as at the present day in the low stage the river is artificially kept at a level of about 15 metres by the Delta Barrage and the Aswan Dam, and the average level in the low stage before the Barrage became effective was about 13 metres.

During the last twenty-four years calculations of the discharge at Halfa have been made, and as the result of these it appears in the period July to October, which is usually taken as the flood period, the discharge of 1913 is between 50 and 60 per cent. below the average. In early times the effect of such a flood would have been disastrous, but the recent raising of the Aswan Dam, the reservoir being filled to its full capacity for the first time this year, and the construction or strengthening of the four barrages on the Nile, have removed the possibility of extensive loss and enabled the deficiency, due to the late arrival of the flood, to be tided over.

There is no need to point out the importance to Egypt of a knowledge of the causes of the Nile flood, and of the value of a prediction which could be given with fair accuracy a month beforehand. The flood of this year having been so exceptional, there is every possibility that useful clues may be obtained to its detailed causes, and to further this object I should be glad to have copies of any meteorological observations made in Central and South Africa, and the South Atlantic in this and previous years.

H. E. HURST.

Meteorological Office, Survey Department,
Giza (Mudiria), Egypt.

Pianoforte Touch.

I DO not think that Prof. Bryan will find any difficulty in sounding a single note of the same loudness a sufficient number of times for the test suggested, if he eliminates, as I did, those which are perceptibly louder or softer than the average; and the task for the listener is a very different one from sipping blindfold coffee and tea, where the two different tastes persist for a long time, and soon become hopelessly superposed. Certainly the problem as to whether a difference is caused by the nature of the blow given to the strings cannot be solved by playing a succession of notes, instead of a single one, for such a succession at once introduces a number of other factors.

The instrument which I used was an Erard grand of the latest type. Such an instrument, owing to the fact that the hammer strikes the string twice for each blow on the keys, is specifically favourable for producing differences which might be impossible in other cases.

SPENCER PICKERING.

MR. PICKERING tells us that in his latest Erard piano "the hammer strikes the string twice for each blow on the keys." If this is really the case the statement will go a long way towards clearing up the theoretical difficulties which have arisen in the attempt to explain the possible production of variations of tone quality by differences of touch. It is very difficult to obtain any definite information regarding the action of pianoforte hammers. Both Helmholtz's and Kaufmann's theories are inadequate, and an investigation recently started with one of my pupils seems to show that the action is much more complex than is usually supposed. But inquiries in other directions have merely elicited the dogmatic statement that the whole object of the check action is to prevent the hammer striking the string twice. In my Collard horizontal piano of 1802 the arrangement of the check action is distinctly favourable to a multiple impact, for when the action is removed and the hammer projected into the air it certainly rebounds considerably. Granting such an action to take place, we are no longer thrown back on the vibrating-shaft theory as the only *possible* explanation. The extent to which such effects are or are not noticed must necessarily be a matter of personal opinion, although I hope shortly to repeat the experiment described by Mr. Pickering when I can obtain a music-roll cut with the necessary repetitions.

G. H. BRYAN.

Alfred Russel Wallace Memorials.

MAY we appeal through these columns to men of science, both here and abroad, to contribute to a fund which we are raising for the purpose of placing a suitable memorial to the late Dr. Alfred Russel Wallace in Westminster Abbey? We should like also to be able to offer to the Royal Society a posthumous portrait of the late distinguished naturalist, and Mr. J. Seymour Lucas, R.A., has consented to execute this work. It is further contemplated that a statue or bust should be offered to the trustees of the British Museum (Natural History) if the necessary fund is subscribed. In view of the great services to the cause of science rendered by Darwin's contemporary and colleague, the duty of handing down to posterity a memorial worthy of the man and his work obviously devolves upon those of the present generation who have in so many diverse ways benefited both by his teaching and by his example. The whole sum asked for to enable us to carry out all the objects which we have in view is comparatively modest, viz. 1100*l*., and we hope that this amount will be reached. The preliminary list of subscribers is sufficiently weighty to convince us that in undertaking the organisation of this movement we have not only the sympathy of the scientific world, but also the approbation of leaders of thought and of culture in other spheres of activity. Thirty fellows of the Royal Society, including the present and past presidents, have already given their adherence, and among those representative of other interests will be found the names of Mr. Arthur Balfour, Lord Haldane, Dr. Warren, the president of Magdalen, and the Dean of Westminster. We have only to add that permission to place the memorial, which it is proposed should be in the form of a medallion with a suitable inscription, in Westminster Abbey, has been cordially given by the Dean and Chapter.

We shall be willing to receive and acknowledge subscriptions, but it will be most convenient if these are sent directly to the manager, Union of London and Smith's Bank, Holborn Circus, E.C., in the form of cheques made payable to the "Alfred Russel Wallace Memorial Fund."

RAPHAEL MELDOLA,
6 Brunswick Square, W.C.
EDWARD B. POULTON,
Wykeham House, Oxford.
JAMES MARCHANT,
(Secretary), 42 Great Russell Street, W.C.

THE family of the late Dr. Alfred Russel Wallace having invited me to arrange and edit a volume of letters and reminiscences, they would be thankful if those of your readers who have letters of reminiscences would kindly send them to me for this purpose. The letters would be safely and promptly returned.

Will provincial American, Colonial, and foreign newspapers kindly republish this letter?

JAMES MARCHANT.

Lochnagar, Edenbridge, Kent.

Distance of the Visible Horizon.

ABOUT forty years ago I learnt a formula which I have used ever since. It was $7x = 4y^2$; x = height of observer in feet, y = distance of horizon in miles. I do not now know where I found this formula, but it will be seen, if a few examples are worked out, that it agrees very closely with that given in your issue of November 20. At 1000 ft., for instance, the distances are 42 and 41·9 miles respectively.

R. LANGTON COLE.

Sutton, Surrey, November 30.

THE PROBLEM OF THE UNIVERSITY OF LONDON.

THE University of London problem is still unsolved. Within the memory of most of us there have been *three* Royal Commissions on the University, and some of us are beginning to think that the problem is insoluble.

It will be remembered that the present constitution of the University was based upon the report of the Gresham Commission in 1891. The recommendations of the Gresham Commission were not adopted fully and completely, but, from many important points of view, were modified by the terms embodied in the schedule to the Act of 1898. The Act of 1898, under which the University now works, and under which it became a teaching as well as an examining university, was frankly a compromise, and few who were intimately connected with university organisation anticipated that the compromise afforded a lasting, much less a permanent, solution.

The 1898 Act took effect in 1900, so that the University has been working under its present constitution for a period of thirteen years. It started on its new career as a teaching university with a list of "recognised" teachers that had been drawn up for it by the Statutory Commission. It had no real control over teaching, nor did it own or possess any teaching institution.

It was not until 1907 that the University became in any real sense of the word a "teaching university." This was brought about by the incorporation of University College. In order to aid and promote the aims of the reconstituted University, the old corporation of University College agreed to be dissolved, and to transfer its powers and property to the Senate of the University. By this means the University became possessed of land, buildings, and educational appliances of great value, and acquired a teaching staff of high distinction, and an academic organisation of proved efficiency and honourable tradition.

The step taken by University College was followed, so far as circumstances permitted, by King's College, which was incorporated in the University two-and-a-half years later. Since that time the development of the teaching side of the University has been rapid. It would have been *more* rapid, but for the hindrances of the present constitution. But for those hindrances, the Imperial College of Science and Technology, which was constituted about the same time as University College was incorporated in the University, would also, from the first, have been part and parcel of the University. As things stand, the Imperial College is only linked to the University by the slightest of all links—that which is implied by the style and title of a "school" of the University.

The rapid progress of the organisation of teaching and research, the desirability of incorporating the Imperial College, and the need for a constitution more adapted to university government than the present, led to the appointment of a new Royal Commission in 1910. The report of that Commission was issued last April. This report has been generally acclaimed by educational experts as setting forth in an admirable fashion the aims and needs of a university placed in a great city such as London.

The report contains detailed suggestions for the reconstitution of the University, and at the same time suggests far-reaching educational reforms, for which it will take many years to prepare. It is this blending of proposals that may be immediately effective with schemes that cannot mature for many years to come that makes the report leave in some respects a *doctrinaire* impression. It appears to us, therefore, that the President of the Board of Education has taken the only possible practicable step in the circumstances in appointing a departmental committee "to consult the bodies and persons concerned, and to recommend the specific arrangements and provisions which may be immediately adopted."

In a recent speech at the Mansion House, the Minister for Education laid down the principles upon which immediate action might, in his opinion, be taken. He has confirmed those principles in a letter dated November 12 addressed to the vice-chancellor of the University, and published in our issue of November 20. We agree with him in the view that the five principles he lays down are the *essential* principles. If they were once adopted, the main difficulties that at present exist would undoubtedly disappear. Under these principles, the supreme governing body of the University will be a senate, small in size, predominantly lay in composition, and in no way representative of special interests. Its supreme business will be to guide and direct the high policy of the University, especially so far as that is affected by finance. It will not be overloaded, as the present Senate is, with every imaginable detail. A reference to the agenda paper of the present Senate will show that it concerns itself with everything and anything, from the wages of a lift-boy up to the appointment of a university professor.

The composition of the Senate that is proposed would only be possible if it were assisted in its work by a number of well-organised bodies. Among these, the most important are the faculties, consisting in the main of the University professors and University readers, all of whom in future will be appointed by the University Senate. To these faculties will be committed very great powers. They will, of course, be subject to the general control of the Senate, and to the statutes and ordinances existing for the time being. Subject to those, the faculties will determine the courses of study, the subjects of study for degrees, and all the details of educational work. It is clear that if the faculties are to do their work effectively they must be composed of teachers of the highest rank, and those teachers must be able to meet frequently and easily. The more directly and completely those teachers are controlled by the

Senate, the more effective will be the unity of the University organisation.

This being the case, the Commission recommends a considerable extension of the policy of incorporation, to which we have referred already. It recommends the extension of the principle of incorporation to the Imperial College of Science and Technology to Bedford College, and possibly to the East London College. It recommends that the Birkbeck College be incorporated, and be made an "evening school" of the University; and further, that some (possibly three) of the medical schools become incorporated medical colleges.

The incorporated institutions will be the property of the University; they will be under its educational and financial control; but the property will be so vested as not to preclude the earmarking of capital or income by donors and benefactors for particular institutions or specific purposes. All institutions thus incorporated will be known as "constituent colleges." The details of management of such institutions will be in the hands of college committees or delegacies, as, under existing conditions, is the case at University and King's Colleges.

Such being the general programme of the Commission, it follows as a matter of necessity that "as much of the University work as possible, together with the University administration, should be concentrated in a central University quarter." This brief statement by the Minister of Education ought to do much to clear away the confusion raised by what has been called "The Battle of the Sites." The Minister's statement, taken in conjunction with the report of the Commission, makes it perfectly clear that a site that merely provides the administrative offices of the University will not, in any circumstances, meet the needs of the case. If administrative offices, and administrative offices *only*, are sought, then there is small reason for removing from the present quarters in the Imperial Institute. To move the administrative offices from there to some costly site on the south side of the river, as has been suggested, would be wasteful and futile. It would be wasteful because it would require a very large sum of money even to move the administrative offices from South Kensington to the south side of the river; it would be futile because, when the removal was achieved, the University administration would not be nearer to any teaching centre than it is now.

It has been suggested that the Government should be asked for Somerset House for University purposes; and this proposal has been reported upon favourably by the Higher Education sub-Committee of the London Education Committee. At the meeting of the latter Committee on November 26, a report was adopted asking that the London County Council should join with the Senate of the University in a deputation to the Government to set forth the advantages of Somerset House as a university centre. If Somerset House were given to the University, it would undoubtedly be possible to effect a much-needed extension to King's College, and to provide for the housing of the administrative offices; but it would accomplish little, if anything, more; and this would be done at enormous cost, because the whole of Somerset House would need to be gutted. It is almost inconceivable that permission would be given for the alteration of the elevation of this building. The University would again be put into a house built for other purposes, and bearing another name; and, instead of a university quarter, all that would be achieved would be the bringing together of the University administration and one of its constituent colleges.

The report of the Commission gives strong reason for the establishment of a university quarter; such a quarter should be large enough to comprise at least two of the main constituent colleges of the University. King's College is undoubtedly cramped for space, and needs room for expansion; its removal is advocated. University College, on the other hand, has fine and permanent buildings; it occupies a site approaching seven acres, while immediately to the south of it, and lying between it and the British Museum, there is an area of some nine acres—or, if roads be included, of some eleven acres—that could, it appears, be acquired for the development of the University. It has been suggested that here could be placed new buildings for King's College, for the administrative offices, for the great hall of the University, and for students' clubs and societies. Here, at least, could be the beginning of a "university quarter" in the real sense of the word, starting with an area of between fifteen and sixteen acres of land: here, too, are possibilities for expansion and development.

In these two colleges all the faculties except that of music are represented, and they may be appropriately associated in a University quarter. The scheme of the Commissioners provides also for the establishment of "constituent colleges" in other parts of London. The report suggests the incorporation of Bedford College and the East London College, and in a special way that of the Imperial College. With regard to this, there seems to be some doubt as to the practicability of the details of the scheme proposed. The Commission suggests the formation of a "committee for technology," which shall at the same time be the delegacy of the Imperial College and the coordinating authority for technology throughout the University; but there is a feeling that these two functions should be kept separate, and committed to different authorities. The idea of a committee, or council, for technology coordinating the technological work throughout the University, and keeping it in touch with the representatives of the great industries, is, however, a sound one.

In conclusion, then, it seems to us that the action of the Minister of Education should lead to a solution of this long-standing problem. It is time that it should be solved. We cannot think that the question of the external degree ought to be allowed to stand in the way of providing London with the University that the capital of the Empire requires. It may be, and we are inclined to think that it is, necesary that the external degree should be continued and maintained. It ought to be easy to devise a machinery for doing this that is not inconsistent and incompatible with the ideals laid down by the Commissioners.

All those concerned in the work of higher education in London—and, indeed, in the country generally—should combine to help in this scheme. There must be give and take. The incorporation principle already adopted by University and King's Colleges was in itself a surrender of autonomy, and other institutons must be prepared to make similar sacrifices if the University is to be a reality. The Minister puts this point well when he says, "Some acquiescence or even sacrifice on individual points will be necessary for all concerned if a scheme worth-having is to be carried out."

THE PLUMAGE BILL.

IN the great question of fauna preservation the newspaper-reading public is at present occupied with the section concerning birds. It is announced by the Royal Society for the Protection of Birds that Mr. Hobhouse will, when Parliament reassembles, bring forward a Bill for restricting the import of plumage into the United Kingdom, and that this Bill will be backed by the President of the Board of Trade and the Under Secretary for India. In its monthly journal, the aforesaid society publishes what purports to be the text of this Bill. It is a very mildly worded measure which will not satisfy root-and-branch reformers, for it exempts from supervision personal clothing worn or imported by individuals entering this country from abroad. Consequently—unless I totally misunderstand the drift of the Bill—worded, like all Bills, with as much legal obscurity as possible—a woman resolved to have head-dresses and robes of forbidden plumage has only to purchase such abroad and stick it into her apparel or her hat, and she passes our Customs houses unchallenged. If my reading is correct, then the results of this Bill will be very slight in stopping the destruction of rare and beautiful wild birds in the British dominions and the colonial empires of France and Holland. But I agree with the R.S.P.B. in welcoming any legislation rather than none, as the thin end of the wedge. We must remember that the first anti-slave trade measure (fought and delayed for many years by spiritual ancestors of the type of plumage-trading firms) was a poor and ineffective thing. But as soon as its justification was grasped by the public it was reinforced by much more drastic legislation.

Mr. James Buckland is quite right to direct attention in vigorous language to the disgraceful amount of beautiful-bird destruction which is going on in Nipal. This quasi-independent Himalayan State has—unhappily—been placed by fate in charge of the most interesting faunistic region of Asia, a country not many years ago famous for the variety and superb beauty of its harmless bird life, notably its pheasants. Originally the Nipalese respected almost religiously the fauna of their native land, like most Indian peoples. But of late they have become infected with a truly British love of life-destruction. They are incited to this by the agents of the plumage trade at Calcutta and other places, and, of course, find it a lucrative business. As in all things but foreign relations we acknowledge the state of Nipal to be an absolutely independent kingdom, it is permitted to import and export goods through British India under its own Customs' seals, intact and unquestioned.

Consequently, though the laws of British India forbid on paper the export of wild birds' plumes or skins, the State of Nipal monthly exports from Calcutta to the feather markets of the world—principally London—thousands of bird skins. The Nipalese have nearly exterminated the Monal pheasant, the Tragopan, and several other gallinaceous marvels. The few people who know and protest on this side are told that Nipal is an independent state and cannot be coerced. But there is no need for coercion. We regulate with Nipal the arms traffic and the opium traffic, and we can easily add to the list of prohibited traffics that in the plumage of rare birds or the skins and trophies of rare mammals. The Nipalese Government, after all, is civilised and can easily be brought to understand that we make our request in the interests of Nipal itself. We have many ways of obliging and disobliging Nipal without resorting to "coercion" in what is really—rightly viewed—a matter of religion.

But of course the weakness of our case and cause is that the present Cabinet—and past Cabinets—and all our Government departments care little or nothing about fauna preservation. They, owing to the faulty education of their component personalities in the preceding century, are unable to view the question from its æsthetic as well as its economic point of view. Consequently few of our London-governed colonies have adequate bird-preservation regulations; while the whole attitude of British India and Burma towards its wonderful and fast-disappearing fauna is one of the scandals of the age. If it were not that the Native States of the Indian Empire have and enforce, so far as they dare, game preservation and bird preservation laws, the Indian peninsula would be now almost lacking in all the more noteworthy types of wild bird and beast. The game regulations drafted by the Viceroy-in-Council for British India were published last year by our own Zoological Society, and forthwith so laughed at for their inadequacy and old-fashioned "game-preserving" character, that they seemingly found their way into the waste-paper basket. At any rate, no far-reaching regulations for fauna preservation have since been published and put in force.

Let scientific men take a broad and lofty view of this question of fauna preservation. Why should any beasts or birds not actively harmful to man or man's interests be killed, except where they are required to provide palatable food for hungry humanity? Why should any more ibexes, markhur, deer, wild sheep, antelope, bear, and such like wonders of creation be destroyed in India, at any rate till by increase in numbers they are prejudicial to the agriculturist? Why should they be killed merely to provide trophies for British officers or tourists, when their life-history is of profound interest and can be studied through the camera, and their presence in the landscape is a source of delight to the eye? Why, similarly, should *any* beautiful birds that are not harmful to crops be killed anywhere for the ridiculous purpose of adorning already-sufficiently-adorned woman? We would-be bird preservers do not object to the unlimited use of ostrich plumes, because such use is supported by the domestication of the ostrich; we do not include the eider duck on our prohibition lists because its down feathers can be obtained without killing the producer; we do not refuse to the trade or the lover of beautiful objects the plumage of several kinds of duck and pheasant, because such can be obtained without bringing these particular types of bird near to extinction. In short, there is enough plumage in quantity and variety to supply all the needs of milliners, dress-makers-and-wearers, upholsterers, and even the purveyors of artificial flies for fly-fishing, without trenching on the rare and specially marvellous birds of the world, or the birds that are of incalculable use as insect destroyers and guano producers.

The apologists of the trade in forbidden birds' skins, or the defenders of the unchecked slaughter of interesting mammals by the rifle, are of a sadly limited type of mentality, so limited that an educated naturalist is not on the same mental plane. Though he can easily parry their arguments, he cannot get them to understand his. But perhaps the foes of Mr. James Buckland who attend to harass him at his lectures are, together with their salesmen-colleagues at London auctions, remarkable beyond others of their class for their want of knowledge of the article they trade in and the local methods of their trade. They do not know for the most part the right name in English or Latin or the approximate habitat of the birds they deal in. As to how the skins are procured, they probably only know that they bought them in Antwerp, Paris, Havre, Amsterdam, Bordeaux, Marseilles, Trieste, Port Said, Calcutta, or Port-of-Spain. They have no knowledge of and no responsibility for the actual half-caste or native agents who do most of the killing or snaring. Occasionally, some specially important firm undertakes a commission for a rich curio-collecting client, and sends out an agent to some distant region to get into touch with the native hunters, but such a firm would scarcely take as much trouble over the bulk of its business—the supply of the millinery houses.

As an illustration of the foregoing remarks, I should like to insert a passage from the writings of Mr. W. Emery Stark, which appeared a few months ago in *The Times of Ceylon*:—

The Trade in Birds of Paradise.

The Papuans (of Dutch New Guinea) are engaged by the traders to act as "hunters." The season, which begins in April, lasts for six months, and for the remaining six months of every year the Papuan spends his time in paddling about, and his money in buying ornaments and luxuries. There is a regular and well-organised trade in birds of paradise. The centre of the trade is at Ternate, where the traders live, and from where they start every year in March for New Guinea. The traders are chiefly Chinese, but there are two or three Dutch trading companies. The Government issue licences for hunting at 25 guilders, or about 2*l.* a gun, and, in addition, the Government charge a heavy export duty on the birds. This year there were 4000 applications for licences, of which 1870 were granted, and one trading company alone secured 240 licences. The traders engage the natives as "hunters," paying the licence and finding guns and ammunition. Each "hunter" is expected to bring in for the season 20 skins of the "great bird of paradise" and 50 to 60 of the ordinary and less valuable sort. The former command at their first price from 1000 to 1200 guilders, or roughly 100*l.* per "corge," *i.e.* 20 birds. In the home market a "corge" realises from 150*l.* to 170*l.*, and a single bird of extra fine plumage has been known to fetch as much as 40*l.* or more. A rough calculation of the 1870 licences issued this year, show that they are likely to result in the production of about 200,000 skins.

I wish the Government had received a steadier backing in the matter of fauna-preservation from the Zoological Society and the British Ornithologists' Union. The attitude of the latter seems to be that so long as museum shelves are stuffed with specimens, birds may be in the landscape or not. The last thing I desire to do is to fetter the researches of professional science. But I would remind fellow ornithologists that it is not only the skin of the bird for classification that is needed, but still more the bones, the muscles, and the viscera, and the living creature itself. This is not the material supplied by the trade collector. Yet, as a concrete example, look at the remarkable deductions in biology which have followed the illustration of the cæca and intestinal tracts in birds and mammals by Dr. Chalmers Mitchell; or the work of A. H. Garrod and F. E. Beddard in myology and windpipes. It is this material which is wanted by the biologist more than an endless multiplication of empty skins—this and the life-study through the camera and the note-book; and all such food for systematists and expounders of the New Bible could be supplied by game-wardens and those who should be placed in control of the wild fauna of our dominions.

H. H. JOHNSTON.

Since the foregoing article was written, there has been placed in my hands a copy of a Government notice recently issued in Egypt—we may be sure not without Lord Kitchener's knowledge and approval—referring to the shooting of animals. Lord Kitchener is no sentimentalist; but alike in his reports and his acts he has continuously used his influence for the preservation of bird-life in Egypt.

NOTES.

THE council of the British Association, acting under authority of the general committee, has made the following grants out of the gift of 10,000*l.* made to the association for scientific purposes by Sir J. K. Caird at the Dundee meeting of the association last year:—(1) 500*l.* to the committee on radio-telegraphic investigations; (2) an annual grant of 100*l.* to the committee on seismological investigations, which is carrying on the work of the late Prof. John Milne, F.R.S.; (3) an annual grant of 100*l.* to the committee appointed to select and assist investigators to carry on work at the zoological station at Naples; (4) 250*l.* towards the cost of the magnetic re-survey of the British Isles, which has been undertaken by the Royal Society and the British Association in collaboration.

FOR the Australian meeting of the British Association in August next year, under the presidency of Prof. W. Bateson, F.R.S., the following presidents of sections have been appointed:—A (Mathematics and Physics), Prof. F. T. Trouton, F.R.S.; B (Chemistry), Prof. W. J. Pope, F.R.S.; C (Geology), Sir T. H. Holland, K.C.I.E., F.R.S.; D (Zoology), Prof. A. Dendy, F.R.S.; E (Geography), Sir C. P. Lucas, K.C.M.G.; F (Economics), Prof. E. C. K. Gonner; G (Engineering), Prof. E. G. Coker: H (Anthropology), Sir Everard im Thurn, K.C.M.G.; I (Physiology), Prof. C. J. Martin, F.R.S.; K (Botany), Prof. F. O. Bower, F.R.S.; L (Educational Science), Prof. J. Perry, F.R.S.; M (Agriculture), Mr. A. D. Hall, F.R.S.

SIR PHILIP WATTS, K.C.B., F.R.S., has received the Order of the Rising Sun (Second Class) from the Emperor of Japan.

THE Royal Society announces that the studentship on the foundation of the late Prof. Tyndall for scientific research on subjects tending to improve the conditions to which miners are subject has been awarded for the ensuing year to Mr. J. I. Graham, of Bentley Colliery, Doncaster, for an investigation into the cause of spontaneous combustion of coal, with special reference to gob-fires.

AT the annual general meeting of the Faraday Society, held on November 26, the following officers and council were elected to serve for the year 1913–14:—*President,* Sir Robert Hadfield, F.R.S.; *Vice-Presidents,* Dr. G. T. Beilby, F.R.S., Prof. K. Birkeland, W. R. Bousfield, K.C., Prof. Bertram Hopkinson, F.R.S., Prof. A. K. Huntington, Dr. T. Martin Lowry, and Alexander Siemens; *Treasurer,* Dr. F. Mollwo Perkin; *Council,* R. Belfield, Dr. H. Borns, W. R. Cooper, Prof. F. G. Donnan, F.R.S., Emil Hatschek, Dr. R. S. Hutton, Prof. A. W. Porter, F.R.S., E. H. Rayner, Dr. R. Seligman, and Maurice Solomon.

IT is proposed to establish a permanent memorial to the late Sir William White, K.C.B., F.R.S. The Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Naval Architects, Iron and Steel Institute, Royal Society of Arts, Institution of Engineers and Shipbuilders in Scotland, North-East Coast Institution of Engineers and Shipbuilders, Institute of Marine Engineers, and Institute of Metals, are supporting the scheme, and have invited their members to contribute. A general committee (under the chairmanship of Lord Brassey) has been formed representing the engineering profession, the Navy and Merchant Service, and some Government Departments. The form which the memorial is to take will depend upon the support which is given to the scheme. It is requested that all cheques be crossed "Coutts and Co.," and made payable to "The Sir William White Memorial Fund," and sent to Dr. J. H. T. Tudsbery (hon. treasurer), Institution of Civil Engineers, Great George Street, Westminster, S.W. The general committee is thoroughly representative, and includes the president of the Royal Society, and other well-known men of science. The fund already amounts to 1368*l.*

DR. R. T. GLAZEBROOK, director of the National Physical Laboratory, asks us to supplement the article on the British radium standard contributed to our columns last week by Prof. Rutherford, with a reference to the directions which have been issued for sending radium to the laboratory. In the case of radium it is necessary to be particularly careful as to its transmission. It is stated, therefore, in the circular describing the work undertaken by the laboratory, that anyone wishing to send radium for test must advise the laboratory of his intention at least one day previous to sending the specimen. The letter of advice should state approximately the value of the specimen and the method by which it is being sent. All communications and specimens should be addressed to the Director, the National Physical Laboratory, Teddington, Middlesex, and all packages containing specimens should be marked clearly, "R. Department." The laboratory takes no responsibility for the sample until it has actually arrived and a formal receipt acknowledging its arrival has been transmitted to the sender. Samples will be returned ordinarily by registered post, the sender being charged postage and registration fee.

IT has already been fully recognised that Capt. Scott's second Antarctic Expedition was better served in the department of photography than any of its predecessors. The public should therefore welcome the opportunity of inspecting some 150 enlargements of Mr. H. G. Ponting's exquisite photographs—and not the public alone, but those interested in zoology and the study of ice also. These photographs are on exhibition in the gallery of the Fine Art Society, 148 New Bond Street. Some of the ice photographs are of extraordinary beauty and interest, such as the illustration of pressure ridges (No. 81) and that of the cliffs of the Barne Glacier (No. 109). The studies of seals and penguins are wonderful, and must represent the result of infinite patience in securing them. Many of the photographs are known from lectures and the book of the expedition, but in their present form they allow of closer inspection and fuller appreciation. It need scarcely be said that the familiar figures of members of the expedition frequently appear, and add to the interest of the collection.

News is to hand, through the Rome correspondent of *The Times*, of the successful initiation of the gravimetric, magnetic, meteorological, and aërological work of the Italian Expedition to the western Himalaya and Karakoram, under Dr. F. de Filippi. Preliminary observations were made and work done at the Royal Hydrographical Institute in Genoa, and, on arrival in India, at Simla and at Dehra Dun, the headquarters of the Indian Survey. The expedition has a wireless telegraphic equipment, and has already successfully made use of it for time signals, not only between Simla, Delhi, and Lahore, but also between Skardu, in Baltistan, and Lahore. This indicates the utility of this method for field work, even though the receiving station be situated near high mountains, and the determinations of differences of longitude based on these signals, together with latitude observations, will enable observations to be made for the deviation of the plumb-line. When the expedition is at work in districts previously unworked, these signals, if equally successful, will be of high value. The investigation of the upper atmosphere has been begun by means of balloons and theodolite observations on them. A station has been established on the Deosai plateau at a height of 14,000 ft., where pendulum and magnetic work will be done, and solar radiation investigated. Geological excursions are also being made. The expedition will winter, carrying on such work as is possible, at Skardu.

A summary of the weather for the past autumn, issued by the Meteorological Office, shows the peculiarities of the season. The mildness of the weather was the chief peculiarity, and the quiet character of the wind and absence of gales was very striking considering that the temperature was so persistently high, due solely to the prevalence of southerly and south-westerly winds from the Atlantic. The mean temperature for the whole period of the three months—September, October, and November—was 4° in excess of the average in the east of England and in the midland counties, and it was 2° or 3° in excess of the average in all other districts of the United Kingdom. The maximum temperature was 79° in the north-east and north-west of England, and in the midland counties, and the minimum temperature was 22° in the midland counties and in the east of Scotland. The rainfall was in excess of the average in Ireland and over England, except in the north-eastern and north-western districts. The largest rainfall was 14·71 in. in the north of Scotland, and the least fall in any district was 6·58 in. in the north-east of England. The highest percentage of rain was 129 per cent. of the average in the south of Ireland, and in the south-east of England the aggregate rainfall was 119 per cent. of the average. In the east of Scotland the rain was only 78 per cent. of the average, and in the west of Scotland 80 per cent. In the midland counties the rainfall was 110 per cent. of the average, and in the east of England 106 per cent. The rainy days were in excess of the average in England and Ireland. The duration of bright sunshine was generally in fair agreement with the normal. At Greenwich the mean temperature for the autumn was 54°, which is 3° above the average. There were seventy days out of ninety-one with the temperature above the average, and frost occurred on only one day. The bright sunshine was seventy hours more than the average.

The annual general meeting of the Royal Agricultural Society of England was held on December 10 at the Royal Agricultural Hall, Islington. From the report of the council of the society presented on this occasion we notice that the work at the Woburn Experimental Station continues to expand. This has so far been recognised that a grant of 500*l*. was made during the year from the Development Fund in aid of the experimental and research work carried on. As regards the field experiments, in addition to those on continuous wheat barley, the rotation and green-manuring experiments have been further carried on, as well as work on varieties of oats, varieties of lucerne, clover, and grass mixtures, linseed, soya bean, &c At the pot-culture station, in addition to a continuation of the work on lime and magnesia, the principal fresh research was on the action of copper, zinc, and manganese salts on the wheat plant, and of lithium salts on tomatoes. The practical demonstration of the eradication of wild onion by the growing of deep-rooting grasses and plants was clearly shown at Chelsing, Herts, the results of the system adopted being this year very marked. During the year 196 complete analyses, that is for purity and germinating capacity, and seventy-four rough analyses and comparisons of bulks with samples, were made. Eight prescriptions for mixtures for the formation of permanent pasture were drawn up, and three analyses of mixtures made. One of these mixtures, said to be a cheap one, was found to contain about 1 per cent. of seeds useful for the purpose, the remaining being weeds and the screenings of a wheat crop. The experiments which were begun at Woburn early in 1911 for the purpose of demonstrating that by means of isolation it is possible to rear healthy stock from tuberculous parents have been brought to a close. One of the experimental animals was killed in December last and the others in the course of the present year. After slaughter a searching post-mortem examination was made, but no evidence of tuberculosis was found in any case. A full account of the experiments will be published later.

Physical anthropologists are unwearied in their search for anatomical characteristics which may serve as tests of race. The last essay of this kind is that of Mme. Bertha de Vriese, under the title of "La signification morphologique de la rotule basée sur des recherches anthropologiques," published in *Bulletins et Mémoires de la Société d'Anthropolgie de Paris* (6th series, parts 3–4), in which the writer has collected numerous measurements of the patella among various races. The article commends itself as an important contribution to comparative anatomy.

In the November issue of *Man* Mr. J. W. Scott Macfie describes a collection of curiously carved wooden staves from West Africa. They are used in the cult of Shongo, god of thunder and lightning. Childless women pray to Shongo for offspring, and when a son is born he is dedicated to the god. He is taken to the shrine, a ram is sacrificed, and the boy is given a staff, with directions to keep silent for a period which may extend to three months. Adults also carry these staves, and make a vow of silence for recovery of health. In the course of this rite, the patient pours the blood of a sacrificed ram on some stone celts, believed to be thunderbolts sent by Shongo. A smaller variety of staff is kept in houses to represent Shongo. Sacrifices are made before them, and thus they are regarded as Ju-ju, or sacred, and the owners are very unwilling to part with them.

PALÆOLITHIC natural history forms the title of an interesting article by Mr. R. I. Pocock in *The Field* of November 29. It is illustrated by reproductions of prehistoric sketches of various animals, together with photographs of their nearest existing representatives.

To Mr. A. E. Cameron, the author, we are indebted for a copy of a paper, published in the September issue of the Transactions of the Entomological Society, on the life-history of *Lonchoea chorea*, a fly which, in the larval stage, does a certain amount of damage to diseased beet crops.

MR. W. JUNK, the well-known Berlin publisher, announces the issue of a reprint of H. Loew's "Die Europaeischen Bohr-Fliegen (Trypetidæ)," at a subscription price of 6*l.*, to be raised after publication to 7*l.* 10*s.* Although this fine folio was originally published so long ago as 1862, it is still the basis of our knowledge of this family of Diptera. The reproduction of the photographs will, it is stated, be superior to that in the original edition, in which the prints have become faded and stained. In another circular the same firm directs attention to the "Coleopterorum Catalogues," of which fifty-five parts have been already issued.

THE very remarkable vertebrate fauna of the Permo-Carboniferous beds of north-central New Mexico forms the subject of a fully illustrated memoir by Messrs. Case, Williston, and Mehl, issued, as Publication No. 181, by the Carnegie Institution of Washington. The species from this horizon at present identified include a shark akin to Pleuracanthus, five amphibians, and ten reptiles of a low, although in some cases specialised, type. The most remarkable of the amphibian remains is a skull described as a new genus and species under the name of *Chenoprosopus milleri*, the generic designation referring to the curious superficial resemblance of the specimen to the skull of a goose. The genus is believed to belong to the temnospondylous amphibians, in spite of certain indications of affinity with reptiles. Among undoubted reptiles special interest attaches to the restoration of the skeleton of the pelycosaurian described by O. C. Marsh as *Ophiacodon mirus*, on account of the enormous size of the skull as compared with that of the trunk. According to the figures, the shoulder and pectoral girdles of this and certain allied forms present a striking resemblance to the corresponding elements of African anomodonts.

IN the course of a lecture on zoological gardens delivered before the Royal Society of Arts on November 27, Dr. Chalmers Mitchell, secretary of the Zoological Society directed attention to the tastes of the general public in regard to establishments of this nature, pointing out that much greater interest is taken in watching the gambols and other habits of well-known animals than in observing rare species, or in contrasting one species with another. This, of course, is only natural, and as the members of the public supply the greater part of the funds by which menageries are maintained, it is only right and proper that their tastes should be consulted and catered for. Not that the lecturer was by any means unmindful of the scientific value of menageries. On the contrary, he pointed out that such establishments afford practically the only means of obtaining a knowledge of the comparative psychology of animals—a subject of which we are still profoundly ignorant. "I have no doubt," he observed, "if we made use of the opportunities that menageries can afford, that we should find groups differing in structure equally different in natural disposition, in mental and emotional quality, in the power of forming new habits, in the quality of their intelligence." Attention was also directed to the improvement in the condition of menagerie animals, and their increased longevity, as the result of the open-air treatment, as contrasted with the old "cossetting" system; while a considerable portion of the discourse was devoted to a description of the new "Mappin Terraces," and the "Caird Insect House," and the advantages which will accrue to the menagerie as a popular resort when the former are in full working order.

THE first number of *The Indian Journal of Medical Research*, published in July of this year, consists of more than 200 pages, with fourteen plates, and contains a number of important contributions. First in order is a memoir by Capt. W. S. Patton and Capt. F. W. Craig on certain hæmatophagous flies of the genus Musca. These are congeners of our common English house-fly, and, like it, have the proboscis soft and not adapted for piercing. Being unable, therefore, to puncture the skin of man or animals, they obtain the food they require, namely blood, by associating themselves with common biting flies, such as Stomoxys, Tabanidæ, &c. When one of these biting flies has put its proboscis through the skin the Musca approaches it, and will endeavour to thrust its proboscis into the wound, and to oust the first occupant. Sometimes several crowd round the same biter, and when they have succeeded in dislodging it, or when it has completed its meal, they suck up the blood from the wound. It is possible that these flies may play a rôle, hitherto overlooked, in the transmission of disease. Four species, two of them new, are described in detail with the help of excellent figures drawn by Mrs. Patton.

MAJOR H. G. J. DE LOTBINIÈRE has contributed to *The Quarterly Review* for October (No. 437) a concise and valuable paper on the principal forest resources of the world and the steps which have been taken in Britain and elsewhere to provide for the future. He points out that before many years the timber cut in Russia—our main source of supply, and the only important reserve left to draw upon—will exceed the annual growth, so that exports will decline; that in the majority of other timber-producing countries the forests are, or soon will be, insufficient to meet the rising demand for local consumption; and that the only forest reserves of coniferous timber as yet untouched are in regions difficult of access, in Siberia, British Columbia, and the Andes. The position so far as this country is concerned is serious, but not yet hopeless, for Britain is admirably adapted for timber-growing, though it will take years of industry to bring the soil back to forest conditions. The author makes a number of timely and practical suggestions regarding the lines on which a scheme of afforestation for suitable portions of the sixteen million acres of mountainous and heath land in Britain should be prepared, and strongly urges the necessity for immediate action.

The Journal of the Department of Agriculture of South Australia contains, amongst many interesting articles, brief reviews of the proceedings of the agricultural bureau meetings. The bureau, which possesses more than 150 branches, is essentially carried on to provide facilities for papers on subjects of agricultural interest being read by the farmer members, and to encourage mutual help. Without wishing to imply that the English farmer is endowed with these attributes for imparting and receiving information, as is his Australian cousin, it would appear natural that he should be prepared to attach more importance to advice obtained from a practical man than from a stranger in the form of an agricultural adviser. The adoption of farmers' bureaus in this country might be productive of much good work by stimulating the practical man to compare and to analyse variations in practice and profitability and to arouse greater interest in the daily routine.

An interesting article by Mr. A. O. Walker, on weather fallacies, is contained in *Symons's Meteorological Magazine* for October and November, from experience gained as an observer for more than forty years. The first subject of attack is the Meteorological Office weather forecasts, but the criticisms do not imply any censure of the staff of that office, but are written from an agricultural point of view. Selecting two or three of the author's remarks: during hay harvest, *e.g.* a farmer wants to know what the weather will be two or three days *after the hay is cut.* Thunderstorms will occur independently of calculations as to exact time and place, and neighbouring stations are differently affected. Monthly averages of rainfall are often misleading; at Ulcombe (near Maidstone) for the years 1900–9 February had the lowest average, 1·62 in., and October the highest, 3·10 in. But in 1900 the two months changed places: October 1·76 in., and February 3·75 in., the wettest month of the year. Monthly mean temperatures are also apt to mislead, as they give little idea of the intensity of cold or warm spells. It is a common belief that temperature falls as height increases, within such limits as, for example, are found in south England; it is generally true as regards day temperature, but not as to night temperature. This is shown by the greater immunity of tender shrubs half-way up a hill from injury by frost compared with those at the foot. Snow is believed by some to have a special fertilising effect, but all that can be said of it is that in times of severe frost it protects the roots of plants.

The *Journal de Physique* for October contains a paper by M. R. Détrait describing his researches on the slipping of liquids at the surfaces of solids. The accuracy with which the flow of a liquid through a capillary tube can be represented by the fourth power of the radius is a sufficient guarantee that at the velocities usual in such tubes the slip, if it exists at all, is small. To put the question to a severe test, M. Détrait has compared the times of flow of equal volumes of water and petrol through tubes of glass, which both liquids wet, and through tubes of sulphur, which the petrol alone wets. The experiments show that there is a measurable slip of a liquid past a solid it does not wet, which in the case of water flowing in a sulphur capillary tube leads to an excess flow equivalent to an increase of radius of the tube by about one-thousandth of a millimetre.

The nature of the gases liberated by the autolysis of different organs and tissues forms the subject of a paper by Mr. F. Traetta Mosca in the *Gazzetta Chimica Italiana* (vol. xliii., ii., 144). Striking differences are shown by the different tissues, pointing to wide differences of enzymic activity; the liver, kidneys, brain, and suprarenal capsules liberate mixtures of carbon dioxide, nitrogen, and hydrogen in different proportions, whilst the intestines give in addition carbon monoxide and oxygen; from the pancreas, spleen, lung, and heart it is remarkable that nitrogen alone is evolved. In the majority of other cases also the relatively high proportion of nitrogen and hydrogen is a striking phenomenon of the protein degradation; thus in the case of autolysing calves' brain, 71·6 per cent. of the gas evolved consists of nitrogen and 22·4 per cent. of hydrogen, whilst from the suprarenal capsules 40 per cent. of the gas is nitrogen and 50·4 per cent. hydrogen.

The Department of Mines of New South Wales has issued a pamphlet on mercury or quicksilver in New South Wales, with notes on its occurrence in other colonies and countries (Mineral Resources, No. 7), by J. E. Carne. The occurrence of mercury, in the native state or in the form of cinnabar, has been indicated in some ten localities, but the quantities produced hitherto are very small, one of the most favourable localities having yielded only about 10 cwt. of metal to the company which attempted for a time to exploit it. The general reader will, however, find that much interesting information has been brought together in the present report with reference to the production of mercury in other countries. An account is given of the wonderful mines at Almaden, in Spain, which are known to have yielded some four million flasks, or 140,000 tons of metal, whilst the Californian mines have given about half this quantity. It is pointed out that wet-concentration has proved useless, in spite of the high density of the mineral, and that efficient working of the ordinary low-grade ores (yielding 0·5 to 2 per cent. of mercury) is only to be effected by careful attention to economical working of the furnaces; the gases must escape at the lowest temperature which will retain the mercury as vapour, and the hot spent ore must be used to heat the air-supply of the furnaces. As illustrating the difficulty of retaining the metal, it is mentioned that at the New Almaden mine in California, 2000 flasks (135,000 lb.) of mercury were taken from the ground under one of the furnaces, the metal having penetrated 27 ft. to bedrock.

The Engineer for December 5 contains an account of the motor ship *Arum*, launched last week from the yard of the builders, Messrs. Swan, Hunter and Wigham Richardsons, Ltd. This vessel is an addition to the comparatively small number of motor ships of which both hull and engines have been built in this country. Her dimensions are 360 ft. length over all, by 47 ft. beam, by 27 ft. moulded depth; she is to carry about 5600 tons dead weight on a draught of 21 ft. 6 in. The main engines, built by the same firm, consist of a pair of four-cylinder two-cycle reversible Diesel engines, designed for 1150 brake-horse-power at 135 revolutions per minute; the speed will be about 10.5 knots. The vessel has been built to the order of Sir Marcus Samuel for the carrying of general cargo, and is to trade to the Persian Gulf. Oil from the Persian oil wells is to be employed, a favourable ten years' contract having been secured for the supply of Sir Marcus Samuel's fleet.

An illustrated article in *Engineering* for December 5 on the channel steamer *Paris* gives some up-to-date information regarding the development of geared turbines. Absence of wear, freedom from noise, durability, and low frictional loss have been achieved. The loss due to transmission and reduction with double helical wheels is under 2 per cent., whereas in the hydraulic and electrical systems it is quite five times as great. It has been contended that the windage loss in the running idle of the astern turbines partly nullifies this advantage; as the astern turbines revolve in the vacuum of the condenser, the losses for them amount to only 0·5 per cent. Accounting also for the loss due to the thrust-block associated with geared turbines, the mechanical gearing gives an efficiency of about 97 per cent. as compared with about 90 per cent. in other systems. In the *Paris*, the power transmitted through two gear-wheels is 14,000 shaft-horse-power. It is but four years since the first use of such gearing, and to-day there are 435,450 horse-power completed or under construction.

The 1913 issue of "The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland" has been published by Messrs. Charles Griffin and Co., Ltd., at the price of 7*s*. 6*d*. It will be remembered this useful annual publication is compiled from official sources, and it is appropriately described on the title-page as a record of the work done in science, literature, and art during the session 1912–13 by numerous societies and Government institutions. We notice in the case of the British Association that though particulars are given of the meeting held at Dundee in September, 1912, no information about the Birmingham meeting of September last is included.

OUR ASTRONOMICAL COLUMN.

The Structure of the Universe.—The November issue of *Scientia* contains an article by Prof. J. C. Kapteyn, entitled "On the Structure of the Universe," which should be read by all those who wish to obtain the most modern view of this most fascinating problem. It was Prof. Kapteyn who, in 1904, first determined the elements of the two star streams, and since then a great advance has been made in extending our knowledge in this direction. In the present article, and, it may be added, it is written in a very clear and concise manner, he places before the reader the general nature of the problem, and step by step he points out how the various researches of many observers are coordinated and brought to bear in concentrated form on the question of the structure of the universe. The subject being so vast, he confines himself here mainly to that portion concerned with star-streaming, and considers the questions, What has the discovery of star-streaming done, and, What does it promise to do for the solution of the problems (1) that of the distance, and (2) that of the history or evolution of the stellar system. Prof. Kapteyn utilises a modified form of Secchi's stellar classification, and states that there is much evidence to show that this classification is a natural one, and that the order of evolution is as follows:—The helium stars being those of recent birth, while we come to older and older stars in passing from the helium stars to the stars of the first, then to those of the second, and finally to those of the third type.

In speaking of the spectra of such groups of stars as the Hyades, Pleiades, Ursa Major group, &c., he says:—"The groups that do not now contain any helium stars must have contained them formerly in great numbers. Going back in time still further, these helium stars must have been generated from some other matter, probably nebulous matter. Therefore in a remote past the groups of the Hyades and Ursa Major must have been full of nebula. So far as I know there is no trace of nebulosity now. So there must have been an epoch in the past that nebulous matter was exhausted, had probably all gone to the formation of stars."

Journal of the Royal Astronomical Society of Canada.—In the September to October number of the Journal of the R.A.S. of Canada, Mr. H. B. Collier writes on meteorites, and after giving a brief summary of early falls, he refers in greater detail to the "Cape York" meteorites brought by Peary from Greenland, and to the "Williamette" meteorite found nineteen miles south of Portland, Oregon. A very excellent translation from *Ciel et Terre* of a most interesting article by G. van Biesbroeck on the astronomical works of Olaus Roemer, the discoverer of the velocity of the transmission of light, is printed. The fire at Copenhagen in 1728 destroyed most of Roemer's manuscripts, but a portfolio bearing the inscription "*Adversaria*," survived, and has recently been published by the Danish Society of Sciences. Valuable historical facts were contained in it, and are here described. The subject of the boundary survey between Canada and the United States east of the St. Lawrence is dealt with by Mr. T. Fawcett, and he describes the part Airy took in the arrangements for the carrying out of the necessary astronomical work which such a survey demanded. A description is also given of the methods employed on that occasion (1842) by the British and American parties.

New Nebulæ and Variable Stars.—In No. 4697 of the *Astronomische Nachrichten*, Mr. C. R. D'Esterre describes an object the abnormal behaviour of which marks it as one of exceptional interest. He describes it as a new variable star or nova, and its positions for two epochs were (1855), R.A. 22h. 56·3m., dec. +58° 52′; (1900), 22h. 58·1+59° 6·3′. The long period of brightness of the star and rapid decline suggest, as he says, that "we may be dealing with the later stages in the history of a nova." Two charts taken on September 3, 1911, and August 25, 1913, exhibit marked changes in its magnitude. The same writer directs attention to some new nebulæ in the region of l Cassiopeiæ. Dr. R. Furuhjelm, of the Helsingfors Observatory, describes two new variables, both of which have amplitudes of at least three magnitudes. He proposes to continue to observe these objects to secure correct determinations of their periods.

WATTS'S INDEX OF SPECTRA.—Yet another series of appendices to this most valuable compilation of wave-length data has been commenced by the publication of Appendix V. This part begins with the spectrum of the electric spark in air and extends to that of chlorine. The additions include measures of the spectra of the elements Aldebaranium, Cassiopeium, and Beryllium (band spectrum). Among spectra of compounds Olmsted's data for calcium hydride and Fowler's carbon oxide spectra find a place. Perhaps it is not too late to make the suggestion that the policy of giving, in the briefest possible manner, an indication of the contents of the papers referred to be extended to include all references in forthcoming appendices.

SECULAR DESICCATION OF THE EARTH.

ON Monday, December 8, Prof. J. W. Gregory read a paper before the Royal Geographical Society, entitled "Is the Earth Drying Up?" The question is naturally one to which a definite affirmative or negative answer cannot be given owing to the relatively short period during which exact scientific measurements of precipitation have been made. The evidence is principally archæological, botanical, and geological, supplemented for some countries by historic records of population. Prof. Gregory put before the society the views of different investigators, and subjected them to a critical examination, confining himself to changes in historical times, and making no pretence at dealing with the great changes of climate of geological epochs, other than to indicate the glaciers of north-west Europe as the probable cause of the moister Mediterranean climate of prehistoric times.

There are, roughly speaking, three forms of the desiccation theory. Prince Kropotkin maintains that there is a world-wide tendency towards drought. Prof. Ellsworth Huntington believes that the most important changes are pulsatory, the climate being now drier, now moister, but in the long run becoming generally drier. Mr. R. Thirlmere holds that the climate varies in great cycles, each of which may extend over 2000 years or more, and that we are at present in a cooling world. Prof. Gregory examined the evidence from different countries in its bearing on these theories, and showed the results of his examination on a map, from which it appears that there has probably been desiccation in historic times in Central Asia, Arabia, Mexico, and South America; increased precipitation in the United States of America, Greenland, Sweden, Roumania, and Nigeria, and no appreciable change in Palestine, northern Africa, China, Australia, and by the Caspian Sea. He deduces that, though there may be local variations, there is no progressive world-wide change to support the theory of a universal drought. *A priori* it might be affirmed that no appreciable universal change could occur without a corresponding considerable change in the distribution of land and water, or in the intensity of solar radiation. The changes in the former have been small in historic times, and though no direct evidence of solar intensity is available, the records of temperature and of plant life indicate that its fluctuations are probably confined to the short period variations found by the observers of the Smithsonian Astrophysical Observatory.

The strongest support for the desiccation theory is derived from Central Asia, where the evidence, though not conclusive, largely owing to the alternative explanation of blown sand, is sufficiently convincing to have won over the majority of the travellers who have visited that region. E. G.

ASTRONOMY IN SOUTH AFRICA.

A VERY interesting address was given by Dr. A. W. Roberts, as president of the South African Association for the Advancement of Science, at Lourenço Marques on July 7. Dr. Roberts dwelt for the main part on the progress made in astronomy by South African workers during the past century, but he claims pardon for omissions when such a large scope of work has to be considered. He sums up the work of astronomical science in late years as circling round three great problems, namely the distance of the stars, the movements of the stars, and the structure and evolution of the stars. These three lines, he points out, all converge in one great question, namely the constitution, history, and cosmography of the universe as a whole. In reading his address, which is published in *The South African Journal of Science* (vol. x., No. 2, October) one is struck by the great part that has been played by astronomers in South Africa. To use the president's own words:—"It was at the Cape that a sounding line was first thrown across the stellar space. It was at the Cape that the idea of stellar photography was born, grew up, and reached maturity. It was at the Cape, or perhaps by the results obtained at the Cape, that the first vision was got of those wonderful streams of stars that sweep majestically through our universe. It was at the Cape that the classical distance of the sun was reached . . . that the first accurate parallax of the moon, and, later on, its weight, was determined . . . that the most refined measures of stellar distance have been secured." Dr. Roberts tells the story of how—twenty years ago—he had in purpose the determination of the position of the solar apex from the proper motions in Stone's catalogue. "I went," he said, "over my postulates with Gill, and was vehemently assured I was basing my equations on wrong premises. 'How do you know that the stars move haphazard?' he demanded. I did not know! 'They may be moving in streams; the whole universe may be a big whirlpool!'" The record of the past work of South Africa in astronomy is great, and a high standard has been set for the present and future astronomers there.

THE ORIGIN OF ARGENTINE HORSES.

IN the *Anales* of the Buenos Aires Museum for 1912 (vol. xii.) Señor Cardoso adduced evidence to show that the story of the origin of Argentine horses from Spanish horses imported by Don Pedro de Mendoza in 1535 or 1536 is a myth, and that the former are really descended from the Pleistocene *Equus rectidens* and *E. curvidens*, and existed in the interior of the country at the time of the Spanish conquest. This opinion is disputed in the *Revue générale des Sciences* of October 15 by Dr. Trouessart, who points out that the statement of wild horses having been seen by Sebastian Cabot in 1531 is based on the figure of a horse introduced by that navigator in a map of the world in the region now known as Argentina. This, it is urged, is no evidence at all, but merely an indication that the country was suitable for horses. Historical evidence is cited to prove that horses were unknown to the Indians of Mexico, Panama, Peru, and Brazil at the time of the visits of Columbus (1498 and 1502), and of the opening up of the country by his successors. It is then shown that there is a hiatus between the beds containing remains of *E. rectidens* and those with bones of modern horses, while it is argued that the ancient indigenous perissodactyles became extinct as the result of climatic and other physical changes. That the historical evidence in the case of the countries mentioned is decisive may be admitted, but the statements of Señor Cardoso with regard to the existence of large numbers of horses in Argentina in 1580 and the lack of fear of these animals exhibited by the Indians, as well as certain structural peculiarities alleged to be peculiar to Argentine horses and *E. rectidens,* are not referred to by Dr. Trouessart, who had not seen the original paper when writing his own article. A summary of Señor Cardoso's views will be found in *The Field* of July 20, 1912.

FRENCH HYDROLOGY.[1]

THE operations of the French Hydrological Service in the Alps have been so often the subject of notice in these columns that the issue of a fresh volume (tome vi.), bringing the record of results down to the end of the year 1911 for the service in the southern region, does not appear to call for more than passing notice. As is customary, the volume, which is mainly devoted to numerical tables of discharges and other statistical information, commences with a brief description of certain special features in regard to methods of gauging and their adaptation to local conditions. This is followed by a chapter of explanatory remarks on the longitudinal sections and levels contained in the annexe—a case of forty-three plates.

Somewhat fresher ground is opened out by the first volume relating to operations of the same service in the Pyrenees, and detailing the results obtained in the basin of the Adour. In a brief, but very effective, *résumé* of the circumstances which preceded and led up to the establishment of the hydrological service in the south-west, M. Tavernier, who is in charge of this section of the work, records that the hydrology of the Pyrenees has been in the past the subject of greater research and more numerous observations than that of the Alps; and he adds that, while the material thus accumulated is fairly plentiful, it has brought with it the attendant difficulty of its evaluation and coordination, so as to admit of its utilisation in connection with future operations, which are naturally destined to be of a more precise and systematic character. He narrates, in seven successive subsections, the progress of investigation and the nature of the observations made before the inauguration of the departmental service of the Ministry of Agriculture, dating back to a period anterior to the year 1850, and including the records of certain services specially formed, from time to time, to study the phenomena of floods.

When he comes to discuss the relative merits of the regimen of the watershed of the Pyrenees and that of the Provençal Alps, he has some interesting remarks to make on the importance of lakes, which may be rendered as follows:—

The true wealth of the Pyrenees is to be found in close proximity to the summits, where numerous lakes exist, and where artificial reservoirs can be formed. It is quite otherwise in the Provençal Alps, where lakes are scarcely to be found, and where reservoir basins are rare. The lakes of the Pyrenees replace advantageously the glaciers of the Alps, since, in the former case, the outflow can be regulated to meet requirements, whereas the discharges arising from the melting of glaciers are intermittent and irregular, often proving a source of inconvenience because they cannot be controlled.

The second volume of this series is purely statistical and diagrammatic, and deals with the results obtained in the basin of the Garonne down to the end of 1910.

B. C.

[1] Ministère de l'Agriculture: Direction générale des eaux et forêts. Service des grandes forces hydrauliques. (*a*) Région des Alpes: Compte rendu et résultats, Tome vi. et Annexe (nivellements), 1913. (*b*) Région du Sud-Ouest: Comptes rendus et résultats obtenus. Tomes 1 et 2, 1912.

ECONOMIC GEOLOGY OF PAPUA.[1]

THE Commonwealth of Australia has begun the issue of "The Bulletin of the Territory of Papua," of which the first number consists of a valuable report by Mr. J. E. Carne, of the Geological Survey of New South Wales, on the coal, petroleum, and copper ores of part of British New Guinea. Mr. Carne visited the district to the north of the Gulf of Papua in 1912 in order to investigate the value of the coal discovered on the Purari River near the northern foot of Mt. Favenc. The coal proved to be only a brown coal of Cainozoic age, and Mr. Carne regards it as of no present economic value. He visited the Vailala River to inspect a series of gas springs, of which the first was discovered by G. A. Thomas at Opa in 1911. Mr. Carne's samples from these gas springs have been analysed by Mr. Mingaye, who shows that they contain petroleum. The discharge of natural gas is in sufficient quantity to indicate the probable occurrence of considerable supplies of oil in the underlying beds, and Mr. Carne regards the geological conditions as so promising that he recommends the prospecting of the area by adequate boring.

In discussing the relations of this oilfield he gives a valuable summary of the present stage of development of the New Zealand oilfields, and the most recent information regarding the gas well at Roma, in Queensland, and of that at Grafton, in New South Wales. Mr. Carne also visited the Astrolabe copper field to the east-north-east of Port Moresby. Only three of the ore occurrences there were available for inspection at his visit, and mining in the field is at present dormant. Mr. Carne, however, regards the prospects of the field as encouraging, though no final opinion can be formed without further prospecting. His account of one or two of the mines indicate that there are considerable bodies of low-grade ores available. Mr. Carne's memoir contains full references to the earlier literature on the economic geology of the districts visited, and it forms a valuable contribution to the geology of New Guinea.

[1] J. E. Carne: Notes on the Occurrence of Coal, Petroleum, and Copper in Papua. Bulletin of the Territory of Papua, No. 1, 1913, viii. Pp. 116+xxix plates+3 sections+1 map.

METEOROLOGY AND GEOPHYSICS AT THE BRITISH ASSOCIATION.

A MOST important contribution was made by Mr. J. I. Craig, who was unfortunately unable to be present at the meeting. The abnormal warmth of 1911 in Europe prompted Sir Edward Fry to ask in NATURE if the phenomenon was world-wide. Mr. Craig was able to reply for Egypt in the negative, inasmuch as the summer there had been cooler than usual, but he was struck by the definiteness of the opposition, and began to investigate the relation between temperatures in Egypt and south west England, based on values for the past thirty-four years. He found that the departures from the normal in the two countries were in opposite directions in all seasons, as indicated by the correlation coefficient, but the results were much more definite for the first and last quarters of the year, when the values of r were $-0·72$ and $-0·43$ respectively. Mr. Craig then proceeded to calculate the values of r between Egypt and other European stations, and by using the values found he drew *lines of equal correlation.* A little thought shows what a powerful method he has inaugurated for dealing with the problem of centres of action and for localising the centres in a definite manner. It will be for each country in the future to work out the monthly or seasonal iso-correlational lines with itself as base, and to use the charts obtained in determining what information will be useful to it in making its own seasonal forecasts.

Mr. E. Gold and Mr. F. J. W. Whipple showed some curves of frequency of temperature for Kew and Valencia Observatories, which exhibited a double maximum in the annual curve. Roughly speaking, the year may be divided as regards temperature into three seasons, winter, summer, and equinoctial, each season including four months. If the temperature of a particular day of the year were always the same in different years, we should get a relatively large number of warm days at the time of the summer maximum, when temperature changes but slowly from day to day and of cold days at the time of the winter minimum. Actually, the temperature of a particular day of the year varies considerably, and the result is that the temperatures occurring most frequently are not the extremes, but are closer to the mean, and it may happen that they meet and give one single temperature of most frequent occurrence if the annual variation is small enough compared with the variability of a particular day. It may be noted for places similar to Kew in their temperature variations, that in order to experience the largest number of days of temperature 60° F., say, it is necessary to select a place with a mean maximum temperature, either 4° or 5° above 60° F. or 4° or 5° below 60° F.

Dr. J. S. Owens discussed the conditions to be fulfilled by an approved method of measuring atmospheric pollution, and considered in turn nine different methods, none of which were entirely free from objection. One of the simplest, that of collecting the deposit from the atmosphere in a gauge of known area, has been adopted by the Committee for the Investigation of Atmospheric Pollution.

Dr. Vaughan Cornish described a simple method of determining the period of waves at sea by observing the interval between the times when a patch of spent foam is on the crest of successive waves. The method appears to be an excellent one, and ought to be brought to the notice of marine meteorologists, but it is desirable that observations should be made, in connection with the method, to determine what correction is necessary owing to the effect of wind on the foam.

Prof. H. H. Turner, in presenting the report of the seismological committee, referred to the great loss which seismology had sustained through the death of Prof. Milne, who had invariably given some account of the year's work and progress at the annual meeting of the association ever since the committee was formed nearly twenty years ago. Since his death the committee had had an anxious time; it was agreed that the work must be carried on, and the committee had decided that for the present it could not do better than arrange for the collection and discussion of records to be carried on at Shide so far as possible without alteration. Mr. J. J. Shaw, who gave a description of his instrument which was working in the basement of the building, had succeeded in making a satisfactory damping arrangement for the Milne seismograph; this removed the most serious objection which had been raised to the Milne instrument, and it was hoped that the network of stations reporting to Shide would be able to add a "damped" instrument to their equipment.

The Rev. H. V. Gill, S.J., read a paper on the distribution of earthquakes in space and time. He concluded that at least 60 per cent. of recorded earthquakes were associated with others in their neighbourhood.

The Rev. W. O'Leary, S.J., discussed the sources of disturbance of seismometers which are especially sensitive to convection currents. A statement that certain periodic variations were due to the beating of the waves on the west coast of Ireland was challenged by Dr. Vaughan Cornish, who pointed out that the resultant effect of the waves on an irregular coast-line would not have the wave-period; it would probably not be periodic at all.

The Rev. A. L. Cortie, S.J., discussed the connection between sun-spots and terrestrial magnetic disturbances, and suggested that the equatorial rays of the solar corona might represent the stream lines of the solar influence, active in magnetic storms.

Dr. S. Chapman gave an account of an investigation into the periodic variations of magnetic force, by which he sought to test and extend Schuster's suggestion that the changes are due to the motion of ionised air across the vertical magnetic field. He dealt particularly with variations of lunar period, and found that he got eight complex curves for different phases of the moon, which could be resolved into a semi-diurnal variation, and a diurnal variation of which the epoch changed during the month—a change which he attributed to variation in the ionisation of the upper atmosphere due to the variation in the solar-hour angle.

In a joint meeting with Section E, important geodetic questions were discussed. An account of this discussion is given in the report of the proceedings of Section E.

On Monday the meteorologists and other cosmical physicists met together for the annual "meteorological luncheon," and taking to heart Sir Joseph Larmor's comment on the results achieved at the Mount Wilson Solar Observatory, that "if the meteorologists were not careful we should soon know more about the sun's atmosphere than we did about the earth's," the meteorologists accorded the place of principal guest to Prof. Hale's representative, Mr. C. E. St. John, who promised to remember them at his mountain shrine.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

AT the conclusion of the president's address in Section E (Geography), Dr. W. S. Bruce presented his newly completed map of Prince Charles Foreland, Spitsbergen—an island of about 250 square miles, half of which is below the 100-foot contour line and one-fifth covered by glaciers. The rest consists of mountains and huge moraines. The height of Saddle Mount was fixed at 1406 ft., and the Devil's Thumb at 2602 ft. On a later day he gave an account of the economic resources of Spitsbergen, chief among which is an excellent steam coal bordering a splendid harbour, at present mined chiefly by Americans. In view of negotiations from Russia for the purchase of these coal measures, lying only fifty-three hours by cruiser from our coasts, he urged the immediate annexation of the island by the British Government.

Mr. I. N. Dracopoli described his journey across

Jubaland to the Lorian Swamp, and Dr. C. A. Hill the exploration of the limestone caverns of Gaping Ghyll, in Yorkshire.

Friday morning was devoted to local geography. After Miss C. A. Simpson's paper, which dealt in detail with the physical and human circumstances of the Rugby district, Prof. W. W. Watts analysed in masterly fashion the geography of Shropshire. Contrasting the lowlands north and east of the Severn with the uplands of the south and west, he exhibited graphically the influence on rivers, roads, and place-names of the forested Edges and the wooded barrier of the Severn Gorge. The more immediate neighbourhood of Birmingham furnished material for three papers. Mr. P. E. Martineau showed how the Midland Plateau, an upland area of 1000 square miles, sharply limited to the south by a steep escarpment, had marked the meeting of the English invaders from the Humber with the Saxons from Wessex. Mr. W. H. Foxall traced the growth of the city from a market at the convergence of trackways; and Mr. H. Kay contrasted the Black Country, which owed to its varied minerals a population of 1,750,000, a density exceeded on an equal area only in London, with the historical scenery of its borderland.

On Monday, before Dr. Bruce's paper on Spitsbergen, Mr. C. B. Fawcett contributed an anthropogeographic study of fiord lands in relation with the physical conditions of Norway, the north-west coast of North America, and Magellanes. In each region a narrow strip of coast was backed by barren highlands; each had a damp climate unfavourable to agriculture, with an ice-free sea; in each, expansion took place along the waterways. Social development depended on skill in navigation, local and limited among the Magellanes, confined to dug-out canoes among the Amerinds, but highly developed where the Norsemen were in touch with the shipbuilding nations of Europe. Mr. A. G. Ogilvie investigated the origin and growth of two remarkable promontories which screen the Inverness Firth from the Moray Firth, partly through geological changes, partly through tidal and wind currents. Prof. J. W. Gregory gave a lantern lecture on Australia, in preparation for the coming visit of the Association to that continent.

On Tuesday morning the section divided into two parts, one joining with members of Section A to receive papers on geodesy, the other discussing natural regions of the world, the topic being introduced by Prof. A. J. Herbertson. In the latter the most interesting points arose in connection with the place of man in the region. Some speakers held that human interests formed the only satisfactory principle of division; others that the title "natural" excluded man from consideration; and others that man and his environment were so mutually interactive as to be indivisible in such relations.

At the joint meeting with Section A, Capt. H. S. L. Winterbotham, R.E., read a paper on the accuracy of the principal triangulation of the United Kingdom. He said that the work having been carried out in the years 1783 to 1853, the precision of the angular measurements was less than that of most of the continental work, which is of later date. The probable error of an observed angle as calculated from the triangular errors is 1·23″, as against 0·54″ for the mean of all national systems up to 1892. These facts had led to the expression of doubts whether the British work was sufficiently accurate for incorporation with the more modern European work. This question was discussed at the British Association meetings in 1906 and 1908, and in the latter year a letter was written on behalf of the Council of the Association to the President of the Board of Agriculture and Fisheries, suggesting the remeasurement of a small portion of the triangulation remote from the old bases. This has now been done, and there are available as checks six bases in the British Isles (including three measured before 1820 with steel chains), and also a connection across the Channel to the new French meridional arc. The greatest discrepancy found was 1/42000 between the new base at Lossiemouth and the new Paris base.

The accuracy of a triangulation depends not only on the precision of the angular measurements, but also on the "strength" of the figure. In this latter respect the British triangulation has a considerable advantage over most other work. In order to get a rough idea of how far this had compensated for the inferior angular measurements a comparison was made with seventy-seven pairs of bases in all parts of the world. On the assumption that the error generated varied as the square root of the distance from the base it was found that the mean discrepancy for 100 miles of triangulation was 0·0000044 in the logarithm, or 1/99000. Taking the six pairs of bases available for the British Isles, the mean discrepancy was 0·0000029 in the logarithm, or 1/152000. It would appear, therefore, that the principal triangulation is sufficiently accurate for incorporation with the more modern work on the continent, and that if funds became available for remeasuring the British arcs, they would be better employed for other geodetic work.

Capt. H. G. Lyons, F.R.S., read a short paper on the terms used in triangulation, directing attention to the great and confusing differences in the terms adopted. He recommended that the terms first order, second order, third order, and fourth order should be adopted, the order depending on the average triangular error. The discussion showed that the feeling of the meeting was very much in favour of the proposal, and the question was brought up at the meeting of the general committee, and finally referred to the council, with a view to the whole question being brought to the notice of those concerned. M. Ch. Lallemand, in the discussion, stated that the subject was being considered by the International Geodetic Association.

A paper by Mr. E. B. H. Wade, read by Mr. Keeling, gave particulars of some longitude observations in Egypt along a line Helwan–Dagsur to investigate the local attraction in that district. There is a difference in the local attraction between the places named of about 8″.

Mr. B. F. E. Keeling read a paper on the precision of field latitudes in Egypt. The latitudes were observed with a 10-inch Repsold theodolite. The probable error of a single night's observations worked out at about 0·1″, but the agreement between observations on different nights was not as good as this would indicate. To investigate this, a series of monthly observations for latitude were carried out in the grounds of the Helwan observatory, using a procedure identical with that followed in the field. The results were much less accordant than was to be expected from the individual probable errors. A comparison of the different monthly sets of observations (11 in all) gave a probable error for one set of 0·5″, and this would appear to be the correct probable error to assign to the field latitudes of the Egyptian Geodetic Survey.

It was pointed out in the discussion that as these discrepancies were not found at permanent observatories, they must either be due to some peculiarity in Egypt, or more probably to the methods and instruments employed. Among those who took part in the discussions were M. Ch. Lallemand, Col. C. F. Close, and Prof. H. H. Turner.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. F. Horton, of St. John's College, has been approved by the General Board of Studies for the degree of doctor of science.

Science announces that an anonymous gift of 20,000*l*. has been made to Wellesley College. The money was given towards the 200,000*l*. fund which the college is trying to raise as an endowment. The total amount obtained thus far is 90,600*l*.

AMONG the scientific lectures arranged for advanced students of the University of London during the spring term of 1914 are a course of four lectures on carbohydrate fermentation at King's College, by Prof. A. Harden, University professor of biochemistry, at 4.30 p.m., on Mondays, beginning on January 26; and a course of eight lectures on physiological effects of anæsthetics and narcotics, at Guy's Hospital, by Dr. M. S. Pembrey and Mr. J. H. Ryffel, at 4 p.m., on Thursdays, beginning on January 22. The lectures, which will be illustrated by experiments, are addressed to advanced students of the University and to others interested in the subjects. Admission is free, without ticket.

THE annual report for the session 1912–13 of the Royal Technical College Glasgow, has now been circulated. The total number of individual students enrolled was 5069, of whom 610 were day students. The higher work of the college continues to grow in volume and in standard. The roll of students included 135 graduates of the four Scottish universities and of the Universities of Cambridge, London, Manchester, Allahabad, and Calcutta. The arrangements for the affiliation of the college to the University of Glasgow have been completed, and the ordinance of the University Court giving effect to the affiliation received the approval of his Majesty in Council on March 7, 1913. The report gives particulars of twenty-nine works and papers published during the session by members of the college. Details are supplied of the extensions and developments in the various departments of the college and of the continued interest shown by the manufacturers and merchants of the district in the work of the college.

THE Institute of Chemistry has issued in pamphlet form a full report of a conference of professors of chemistry held on October 17 last to consider the relation of the qualifications of the institute to those of other educational institutions; the general question of the training of professional chemists; and the work of the institute in matters of professional interest in all branches. The members of the conference included the officers and members of the council of the institute, the board of examiners, professors of chemistry in universities and colleges recognised for the training of candidates for the associateship of the institute, and in other well-known colleges and technical schools. The pamphlet contains a preliminary statement by the president of the institute, Prof. R. Meldola, submitted as a basis for discussion and circulated among members before the conference, notes received from members before the day of the conference, the report of the conference itself, and expressions of opinion since received. The symposium is of great interest to chemists as bringing together authoritative views on the training and qualifications of professional chemists.

ON Friday, December 5, the London Teachers' Association held a meeting to discuss a report to be made by its education committee on the child and the kinematograph. The report will be based on the personal observations of the members of the committee of visits to picture palaces, on the results of their experience with children, and on the written compositions of 1300 children of Standard III. and upwards on the picture palace. Mr. Albert Smith, chairman of the education committee, considered the subject as regards its moral, physical, and educational effects on the child. Its physical effect was to produce a great frequency of headaches and to increase the number of children demanding eye treatment; its effect on character building was bad; the educational aspect showed that the results in a child's mind was "utter, hopeless, desperate confusion." Two things were needed, an efficient film censorship for all films shown to children and the establishment of educational conditions so that teachers should control films to be used in school work. In Germany the drawbacks of the kinematograph were minimised by proper restrictions. Dr. Garnett said that the London County Council had postponed consideration of this matter for six months. He had doubts whether the kinematograph would be of use in the teaching of history, geography, and industries, but he certainly thought it was of considerable use in the teaching of science, on account of the time-control.

THE annual prize distribution of the Northampton Polytechnic, London, E.C., was held on Friday, December 5, when the prizes were distributed by Mr. Cyril S. Cobb, the chairman of the London County Council. In his report, the principal, after giving details of the work of the institute, referred particularly to the delay in the erection of the technical optics annexe and its serious effect upon the unique work of the polytechnic in this subject. Mr. Cobb, in his address to the students, expressed his regret at the scheme having been apparently pigeon-holed at the Education Office of the council, and promised to unearth it with a view to a definite answer being given to the requests of the governing body in view of the great importance, both to the metropolis and the nation, of carefully planned developments in technological education in optics. Mr. Cobb also dwelt upon the necessity for employers, the apprenticeship system being practically dead, giving facilities for their apprentices and younger workmen to attend technical classes, remarking that if such facilities were not given the time might not be far distant when attendance at such classes might be made compulsory. In the laboratories of the polytechnic an interesting scientific development in electric furnace work was the subject of a lecturette given by Mr. S. Field, the head of the technical chemistry department, with practical demonstrations by Mr. E. Kilburn Scott, another member of the staff, and the inventor of a new type of electric furnace. The furnace is a flame arc furnace, working at high voltages, the three arcs of a three-phase system being produced at the same point in one furnace. Air under pressure is blown, as usual, through the arc, and the nitrous oxide produced is absorbed in appropriate towers, but incidentally the furnace is so arranged that the waste heat of these products can be utilised for steam raising. A still more important feature of the furnace is that the arc can be started and stopped by means of discharges in an auxiliary circuit not part of the high-pressure power supply. This gives a very efficient and convenient form of control. Other and older tyes of electric furnaces were described, and, to some extent, demonstrated. Many interesting details of the work and equipment of the polytechnic were also on view, some of them involving novel features of both educational and scientific interest.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 4.—Sir William Crookes, O.M., president, in the chair.—Sir Francis **Darwin**: A method of studying transpiration. The method is to close the stomata by coating the surface of the leaf with vaseline or some other grease, and then to place the intercellular spaces in connection with the outer air by cutting the leaf into strips. It is found by experience that such leaves transpire at rates comparable to those observed in natural leaves, and that they appear to behave normally in relation to external influences. In the present paper the effect of the relative humidity of the air is considered.—Sir Francis **Darwin**: The effect of light on the transpiration of leaves. The object of the research was to get a general idea of the differences in transpiration produced by alternate periods of diffused light and darkness. The experiments were made on the laurel (*Prunus laurocerasus*) and the ivy (*Hedera helix*), either by weighing or with the potometer. The results proved variable, and only by taking an average of a considerable number of experiments were figures of any sort of value obtained. For Prunus the average transpiration-rates in light and darkness are as 132 : 100; for ivy the figures are 136 : 100.—Prof. J. B. **Farmer** and L. **Digby**: Dimensions of chromosomes considered in relation to phylogeny. It is not possible to maintain that the width of chromosomes is a feature constant for the large phyla of the animal kingdom, inasmuch as not only are there appreciable individual differences, but in closely related species, *e.g.* lobster and prawn, this difference amounts to at least 60 per cent.—J. H. **Mummery**: The process of calcification in enamel and dentine. Although much has been written on the calcification of teeth, the actual mode of deposition of the lime salts has been very little investigated. The author shows that both in dentine and enamel the lime salts are deposited in the globular form, despite the chemical composition of the finished tissues.—A. **Compton**: The optimum temperature of salicin hydrolysis by enzyme action is independent of the concentrations of substrate and enzyme. The optimum temperature of the enzyme in question is independent alike of the concentration of the substrate and of the concentration of the enzyme. —C. F. U. **Meek**: The ratio between spindle lengths in the spermatocyte metaphases of *Helix Pomatia*.—Dr. A. P. **Laurie**, W. F. P. **McLintock**, and F. D. **Miles**: Egyptian blue. The purpose of the research is to decide the exact conditions under which the blue, manufactured and used in Egypt from the fourth dynasty to classical times, is produced, and to clear up the doubts as to its nature and constitution. The results of the investigation are to confirm the conclusion come to by Fouqué that the blue is a double silicate consisting principally of calcium and copper, but in which these metals can be partially replaced by alkalies. When soda, lime, and copper carbonate are heated with an excess of sand, a green glass is formed round the quartz particles at about 800° C. At about 840° the double silicate begins to crystallise out of this magma, again completely dissolving to form a green glass at 890° C. The discovery of this compound by the Egyptians is doubtless due to their practice of glazing small articles carved out of sandstone with a green copper glaze.

Royal Meteorological Society, November 19.—Mr. C. J. P. Cave, president, in the chair.—W. H. **Dines**: The daily temperature change at great heights. When observations by means of registering balloons were first started in England in 1907, it was soon found that the effect of solar radiation upon the thermograph was a matter that must be reckoned with. To avoid the trouble, balloons were mostly sent up a little before sunset, and this policy continued until the meeting of the International Committee at Monaco in the spring of 1909. At that meeting the time of 7 a.m. was fixed for the international ascents, 7 a.m. being the time for which the morning weather chart is drawn. Since then, ascents have been made in England at the specified time, viz. 7 a.m., on the twenty-three specified days per annum. But other ascents have also been made on the international days and on days of special meteorological interest, such as the occurrence of thunder, or of a very high or very low barometer, and such ascents are mostly made in the evening. Some 200 good observations have been made in the British Isles, reaching to about 16 kilometres, concentrated into two nearly equal groups, one with its centre two hours after sunrise, and the other about a quarter of an hour after sunset. Mr. Dines has carefully discussed these records, and finds that above two kilometres and up to the isothermal column, the daily range of temperature, if it exists at all, does not exceed 2° C., and that the maximum is in the afternoon or evening.—H. **Harries**: The eddy winds of Gibraltar. The Rock rises to 1400 ft., and is very exceptionally situated at the entrance to the Mediterranean, and consequently gives rise to great eddies of wind. Mr. Harries on two visits to Gibraltar made some observations on these eddies at the summit signal station, 1310 ft., by means of small balloons and pieces of wadding and wool. As the observations were carried out under nearly calm and also very windy conditions the results are both curious and interesting, and may help to throw light on some of the atmospheric disturbances which are a source of trouble to aviators.

Linnean Society, November 20.—Prof. E. B. Poulton, F.R.S., president, in the chair.—H. J. **Elwes**: The travels of Sir Joseph Hooker in the Sikkim Himalaya. Hooker received in all 110*l.* from Government, and the return was marvellous in comparison with that modest subsidy. The first year, 1849, was devoted to work to the westward, including a part of Nipal, as far as the Yangma valley, and ending in late autumn; the second year was spent in northward exploration as far as the Tibetan boundary at the Donkia pass. Besides the collection of a vast number of plants, Hooker observed the geology and meteorology of the country traversed, and plotted the map which was published in his "Himalayan Journals." A subordinate part was the despatch of more than 1000 packets of seeds to the elder Hooker, by whom they were distributed to many private gardens and nurseries, by which means European cultivators became possessed, amongst other things, of the Himalayan Rhododendrons. Of the literary results of these investigations may be mentioned the two volumes of the "Himalayan Journals," 1854, the splendid "Illustrations of Himalayan Plants," 1855, and the noble "Rhododendrons of the Sikkim Himalaya," brought out in 1849–51 by Sir William Hooker during his son's absence in India.

Zoological Society, November 25.—Prof. E. W. MacBride, F.R.S., vice-president, in the chair.—Orjan **Olsen**: A new Rorqual from the coast of South Africa. A detailed account was given of external characters, biology, and distribution.—Miss Marie V. **Lebour**: A new species of Trematodes of the genus Lechriorchis. The species was found in the body-cavity of a dark green snake (*Zamenis gemonensis*) that had died in the society's gardens.—T. H. **Withers**: Cirripede remains from the Cenomanian Chalk Marl in the neighbourhood of Cambridge. The greater number of the specimens are referred to two species of the family Pollicipedidæ, and add materially to our knowledge of the phylogeny of the pedunculated Cirripedes. Both forms are remarkable for their advanced form of scutum, in which the umbo is subcentral, and show that the transition of the scutal umbo from an apical to a subcentral position was acquired independently by unrelated forms in distinct lines of development.—Dr. P. Chalmers **Mitchell**: The peroneal muscles in birds. The author had dissected these muscles in more than 300 birds, and believed that he was able to give a nearly exhaustive account of the varieties of form presented by these structures. The paper described the peroneal muscles in *Chauna chavaria*, and gave a systematic account of the conditions in the different avian groups which could all be represented as derivatives of the Chauna condition by loss of certain portions and increased development of other portions.

Royal Anthropological Institute, November 26.—Prof. A. Keith, F.R.S., president, in the chair.—M. Fr. de **Zeltner**: The Touareg. The Touareg inhabit a region from the 7th degree of W. longitude to the 6th degree of E. longitude, and the author had explored the whole of this territory from east to west, reaching as far north as Aoudéras, about 150 km. north of Agadez, the capital of Aïr. The main object of the author's expeditions in 1910–11–12 was the anthropological study of the southern Touareg, of whom he measured 145 individuals, three being women. He was able to discover that, despite a certain amount of intermixture, the race presented a great homogeneity, and that it differed distinctly from the neighbouring groups—negroes, Hausa, Peulh, and Moors. Its customs were exclusively feudal, and women played a very important rôle amongst the Touareg, while they were treated with but little consideration amongst their neighbours. Although the Touareg were warriors above everything, yet one could conclude that they were commencing to adapt themselves to a settled life. As their pillaging expeditions became from day to day more difficult, a number of them were beginning to devote themselves to agriculture, forcing their captives to work, and obtaining good results therefrom. Internally there was absolute tranquillity in the Touareg country.

December 2.—Prof. A. Keith, F.R.S., president, in the chair.—Dr. W. **Hildburgh**: Japanese minor magic connected with the propagation and infancy of children. The lecturer prefaced his paper by describing the kind of magic to be dealt with as principally non-professional, and performed by the ordinary man or woman as distinguished from the professional magician. Starting with various magical cures for, or means for avoiding, barrenness, Dr. Hildburgh showed how some of these depended upon the transference of the soul of a living or dead person to the barren woman, while others depended upon the simulation of a birth, or other mimetic means. Passing then to pregnancy, he discussed the magical means for assuring the safety of the unborn child by protecting it from the attacks of malignant demons and from the effects of inadvertent acts of the mother, and those for predicting its sex and for assuring that the sex should be as desired.

Faraday Society, November 26.—Mr. W. R. Bousfield, vice-president, in the chair.—E. **Vanstone**: The electrical conductivities of sodium amalgams.—A. C. **Rivett** and E. I. **Rosenblum**: The influence of a second solute on the solubility of *ortho*-phthalic acid.

Society of Chemical Industry, December 1.—Dr. W. R. Hodgkinson in the chair.—Dr. E. J. **Russel** and W. **Buddin**: The use of antiseptics in increasing the growth of crops in soil. The action of antiseptics on the soil is shown to be complex, but the most important for the present purpose is that the micro-organic population of the soil is very considerably simplified. The higher forms of life are killed when sufficient antiseptic is added, and the bacteria are greatly reduced in numbers. If the antiseptic is volatile or easily removed from the soil a remarkable result is obtained shortly after it has gone. The bacterial numbers do not remain low, but they begin to rise, and finally attain a level much exceeding that of the original soils. Simultaneously there is an increase in the rate of ammonia production in the soil; the evidence shows that this is the direct result of the increased numbers of bacteria. The increased ammonia production, however, does not set in if a large amount of ammonia and nitrate is already present in the soil. This increased production of ammonia induces a larger growth than in the untreated soils; antiseptics, therefore, tend to have the same action as nitrogenous fertilisers, and could be used to supplement them in practice. The antiseptics used should be destructive to disease organisms, pests, and organisms detrimental to the ammonia-producing bacteria, be capable of being removed from the soil either by volatilisation, oxidation, or decomposition, be convenient in application, and not be absorbed too readily by the soil, or proper distribution cannot take place. Of the various compounds tried during the last three years formaldehyde is the best; then comes pyridine, and then cresol, phenol, carbon disulphide, toluene, and others. None of these are so good as steam, but the subject is yet in its infancy, and there is no reason to doubt that suitable antiseptics will yet be found.

Cambridge.

Philosophical Society, November 17.—Dr. Shipley, president, in the chair.—Dr. **Doncaster**: A possible connection between abnormal sex-limited transmission and sterility. In a previous paper it was shown that the rare tortoiseshell male cat probably arises by a failure of the normal sex-limited transmission of the orange colour by the male. The present communication gives evidence that the tortoiseshell male exhibited is sterile. Two females of the moth *Abraxas grossulariata* in which the normal sex-limited transmission of the *grossulariata* pattern had failed were also sterile; it is therefore suggested that the sterility may be correlated with transmission of a character to a sex which does not normally receive it.—E. **Hindle**: The flight of the house-fly. The paper contains a description of experiments on the range of flight of the house-fly, conducted in Cambridge during the summer of 1912. The results obtained indicate that flies tend to travel either against or across the wind. The chief conditions favouring their dispersal are fine weather and a warm temperature. The maximum flight in thickly housed localities seems to be about a quarter of a mile, but in one case a single fly was recovered at a distance of 770 yards. It should be noted, however, that part of this distance was across open country.—H. H. **Brindley**: Sex proportions of *Forficula auricularia* in the Scilly Islands. In view of collections of the common earwig obtained from two of the islands in 1911 showing as considerable differences in the proportions of the sexes as had been previously observed in collections from various localities in England and Scotland (Proceedings, vol. xvi., part 8, 1912, p. 674), a visit was made to the Islands in August last year. Collections were made in all the five inhabited and seven of the uninhabited islands. There are great differences in the proportions of the sexes in the various islands. The range for different localities on a single island is not great. The evidence that the characters of the soil and vegetation show any relation with the sex propor tions is very slight. The sex proportions in the Scilly Isles show very slight relation with the positions of the islands as regards each other.

MANCHESTER.

Literary and Philosophical Society, November 4.—Mr. Francis Nicholson, president, in the chair.—Prof. Edmund **Knecht** and Miss E. **Hibbert**: Note on some products isolated from soot. The authors gave an account of the laborious work involved in isolating definite organic compounds from soot collected from household chimneys round Manchester. Three of these were obtained, and were described. One such compound is an unsaturated solid hydrocarbon, cerotene, which was isolated in 1783 by König and Kiesow from hay, this being the only other known source. Another substance, obtained in the form of a pure yellow oil, appears to be of the nature of a higher alcohol, and a solid organic acid was also isolated.—Prof. H. C. H. **Carpenter**: The crystallising properties of electro-deposited iron. Specimens of electro-deposited iron sheet of a high degree of purity have been found to exhibit remarkable recrystallisation effects when heated above the Ac3 change, and then cooled below the Ar3 change. In this way relatively enormous crystals are formed in three seconds after cooling below Ar3. The coarse crystals are sometimes "equi-axed" and sometimes "radial." Frequently both types occur on the same specimen. There is no reason for thinking that they are constitutionally different, and they are most probably α iron. These crystallisation effects are only obtained when the thickness of the iron sheet or strip does not exceed a certain critical figure, which is between 0·011 and 0·012 of an inch. The coarse crystals once formed can only be destroyed either by mechanical work or by heating above Ac3 followed by quenching, or by very prolonged heating above Ac3 followed by ordinary cooling rates. The same heat treatment which produces coarse crystals in the electro-deposited iron refines wrought-iron and very mild steel that have been rendered coarsely crystalline by "close-annealing" between 700° and 800° C. On the other hand, annealing at 700° to 800° C. has no effect in coarsening the structure of the electro-deposited iron which has been refined by cold mechanical work. In these respects, therefore, the behaviour of electro-deposited iron is precisely the opposite of that of wrought-iron and mild steel.

EDINBURGH.

Royal Society, November 17.—Prof. J. Geikie, F.R.S., president, in the chair.—Dr. F. **Kidston** Fossil flora of the Westphalian Series of the South Staffordshire Coalfield. More than 150 species were described, some of them being recorded for the first time as British. A few new species were also described.—Prof. Margaret J. **Benson**: *Sphaerostoma ovale* (*Conostoma ovale et intermedium*, Williamson), a Lower Carboniferous Ovale from Pettycur, Fifeshire. The paper also contained the description of a seed referable to Pteridosfernis, and possibly belonging to *Heterangium Grievii*, Williamson.—Prof. C. R. **Marshall**: Studies on the pharmacological action of tetra-alkyl-ammonium compounds. I., The action of tetra-methyl-ammonium chloride. This substance produces paralysis of the myoneural junctions in mammals and frogs. In anæsthetised mammals the intravenous injection of certain doses causes temporary cessation of the respiration, which was found to be synchronous with the paralysis of the nerve-endings in the muscles of the anterior end of the body. The respiratory paralysis was also found to occur after division of both fifth cranial nerves, and therefore could not be due, as has been stated, to stimulation of the endings of these nerves. It was further shown that the effect was not synchronous with the action on the circulation.—Dr. T. **Muir**: The theory of bigradients from 1859 to 1880.

PARIS.

Academy of Sciences, December 1.—M. F. Guyon in the chair.—Paul **Appell**: The development of $(x-y)^{-1}$ in series proceeding according to the inverse of given polynomials.—M. **Righi** was elected a correspondant for the section of physics in the place of the late M. Bosscha, and M. **Grignard** a correspondant in the section of chemistry in the place of M. Sabatier, elected non-resident member.—André **Broca** and Ch. **Florian**: A practical level with a damped mercury bath. The movements of the sheet of mercury are deadened by covering with a thin layer of glycerol, the latter being covered by a sheet of plane glass. Numerous possible applications of the instrument are suggested.—Henri **Chrétien**: Statistical analysis of star clusters.—A. **Demoulin**: A characteristic property of the families of Lamé.—E. **Vessiot**: The reducibility of differential systems.—Serge **Bernstein**: Some asymptotic properties of polynomials. F. **La Porte**: Modifications of the coast of Brittany between Penmarch and the Loire. Near Morbihan the coastline is the same as in 1821; elsewhere the coast-line has retreated, except at Carnac, where 80 to 100 metres have been gained from the sea.—A. **Korn**: The origin of terrestrial magnetism.—F. **Croze**: The peculiarities of the Zeeman phenomenon in the series spectra of oxygen and hydrogen.—A. **Cotton**, H. **Mouton**, and P. **Drapier**: The optical properties of a mixed liquid submitted simultaneously to an electric and a magnetic field.—G. **Ribaud**: The quantitative study of the absorption of light by the vapour of bromine in the ultra-violet. From the results of the experiments the kinetic theory of light absorption does not hold for the large bands; for five lines the theory is in good agreement with observation.—L. **Dunoyer**: An experiment in optical resonance on a gas in one dimension.—G. **Moreau**: Couples consisting of two flames. Two Bunsen flames burn vertically in contact, one containing the vapour of an alkaline salt. In each flame is a platinum electrode, from which, under conditions detailed in the paper, a current amounting to several microamperes can be obtained.—R. **Boulouch**: Systems of centred spherical diopters: ordinary stigmatism and aplanetism.—E. **Aries**: The laws of displacement of chemical equilibrium at constant temperature or at constant pressure.—P. Teilhard de **Chardin**: A formation of carboro-phosphate of lime of the Palæolithic age.—A. **Prunet**: The fungi which cause in France the disease (*piétin*) of cereals. This name is applied to diseases due to the attacks of three different species of fungi.—J. **Stoklasa** and V. **Zdornicky**: The influence of the radio-active emanations on vegetation. In small amounts, the radium emanations favour plant growth, but above a certain quantity the contrary effect is observed.—E. J. **Hirtz**: A new reaction in electrodiagnosis.—Philippe de **Vilmorin**: The hereditary characters of tailless and short-tailed dogs. Y. **Manouélian**: Histological study of the destruction of the acini in the salivary glands in rabic animals.—Adrien **Lucet**: Experimental researches on coccidiosis of the domestic rabbit.—L. **Gaumont**: Contribution to the study of the black fly of the beet.—F. **Ducháček**: A supposed biochemical variation of the Bulgarian lactic bacillus. A criticism of some conclusions of Effront on the variation of the Bulgarian bacillus.—Auguste **Lumière** and Jean **Chevrotier**: A new culture medium very suitable for the development of the gonococcus.—C. **Bruyant**: The peat bogs of the massif of Mont Dore.—E. A. **Martel**: Experiments with fluorescein at great distances. In connection with the use of dyestuffs with great tinctorial properties, such as fluorescein, in tracing the path of underground water-courses, it is shown that the dye need not be previously brought into solution if the water is flowing, and that very large quantities of the colouring matter must be employed if erroneous conclusions are to be avoided. One hundred kilos. of fluorescein were used in one successful experiment.

CALCUTTA.

Asiatic Society of Bengal, November 5.—H. B. **Preston**: A molluscan faunal list of the Lake of Tiberias with descriptions of new species. The paper deals in the first instance with a large collection made by Dr. Annandale at and near Tiberias in October, 1912. A remarkable feature of the molluscan fauna of the Lake of Tiberias is the thickness of the shells of most of its constituent species and the almost complete absence of thin-shelled forms. This is probably due to the large amount of mineral matter held in suspension in the water. The distribution of the different species is discussed under the heading of each, and several new species and varieties are described. With the exception of a species of Unio, these are for the most part minute shells.—R. H. **Whitehouse**: The Planarians of the Lake of Tiberias. Three species of Planaria were taken in the immediate vicinity of the Lake of Tiberias, from which no representative of the group has hitherto been identified specifically.—Dr. G. **Horváth**: Aquatic and semi-aquatic Rhynchota from the Lake of Tiberias and its immediate vicinity. The collection made includes seventy-nine specimens of aquatic and semi-aquatic Rhynchota, representing twenty-one species, of which three are new to science.—Dr. N. **Annandale,** J. C. **Brown,** and F. H. **Gravely**: The limestone caves of Burma and the Malay Peninsula. This paper is divided into three portions. The first is introductory and gives a general account of the caves of Burma and the Malay Peninsula, a history of the literature which has ground up around them since the early days of the eighteenth century, and particulars of their archæology and folklore. Part i. is by J. Coggin Brown, and deals with the geology of the cave-bearing limestones of Burma and the Malay Peninsula. The opinion is expressed that on thorough examination many of the limestone caves of Burma and the Malay Peninsula will be found to contain deposits with recent or subrecent fossil remains. Part ii. is by N. Annandale and F. H. Gravely, and consists of an account of the fauna of the caves. Although both blind and purblind species are included in the list, no animal as yet recorded from these caves has reached the height of specialisation sometimes developed by a cavernicolous existence; such, for example, as is found in the case of certain species from the caves of Europe and North America. An appendix contains notes by Ch. Duroiselle and B. B. Binyabinode on clay votive tablets from the caves.

BOOKS RECEIVED.

Studies in Career and Allied Subjects. Pathology. Vol. ii. Pp. vi+267+xxxii plates. Vol. iv. Contributions to the Anatomy and Development of the Salivary Glands in the Mammalia. Pp. v+364+c plates. (New York: The Columbia University Press.) Each 5 dollars net.

Les Inconnus de la Biologie déterministe. By A. de Gramont Lesparre. Pp. 297. (Paris: F. Alcan.) 5 francs.

Das Relativitätsprinzip. By L. Gilbert. Pp. 124. (Brackwede i.W.: Dr. W. Breitenbach.) 3 marks.

Einführung in die Tierpsychologie auf experimentelle und ethnologischer Grundlage. By G. Kafka. Erster Band. Die Sinne der Wirbellosen. Pp. xii+594. (Leipzig: J. A. Barth.) 18 marks.

Report of the Interstate Conference on Artesian Water. Sydney, 1912. Pp. xv+207+68; maps and plates. (Sydney: W. A. Gullick.)

Société Française de Physique. Recueil de Constantes Physiques. By Profs. H. Abraham and P. Sacerdote. Pp. xvi+753. (Paris: Gauthier-Villars.) 50 francs.

Proceedings of the Royal Irish Academy. Vol. xxxi. Clare Island Survey. Part 64. Foraminifera. By E. Heron-Allen and A. Earland. Pp. 188+13 plates. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate.) 5*s*. 6*d*.

Annals of the Transvaal Museum. Vol iv., part 2. (Pretoria: Government Printing and Stationery Office.) 7*s*. 6*d*.

The Bodley Head Natural History. By E. D. Cuming. Vol. ii., British Birds. Passeres. Pp. 122. (London: J. Lane.) 2*s*. net.

Bulletin of the British Ornithologists' Club. No. cxc. (1) Guide to Selborne. (2) Synopsis of the Life of Gilbert White. By W. H. Mullens. Pp. 27. (London: Witherby and Co.) 2*s*. 6*d*. net.

A Pilgrimage of British Farming, 1910–12. By A. D. Hall. Pp. xiii+542. (London: J. Murray.) 5*s*. net.

Annals of the South African Museum. Vol. vii.; vol. xii., part 1. (Cape Town: South African Museum; London: West, Newman and Co.) 1*s*. and 14*s*.

Linne's Föreläsningar öfser Djurriket. Med Understöd of Svenska Staten för Uppsala Universitet. By E. Lönnberg. Pp. xiii+607. (Uppsala: A. B. Akademiska Bokhandeln; Berlin: R. Friedländer und Sohn.)

The Fungi which Cause Plant Disease. By Prof. F. L. Stevens. Pp. viii+754. (London: Macmillan and Co., Ltd.)

Quantitative Analysis by Electrolysis. By A. Classen, with the cooperation of H. Cloeren. Translated by W. T. Hall. Pp. xiv+308+2 plates. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Logging: the Principles and General Methods of Operation in the United States. By Prof. R. C. Bryant. Pp. xviii+590. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 15*s*. net.

Outlines of Theoretical Chemistry. By Prof. F. H. Getman. Pp. xi+467. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 15*s*. net.

Constructive Text-Book of Practical Mathematics. By H. W. Marsh. Vol ii., Technical Algebra. Part i. Pp. xvii+428. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

Marsh's Mathematics Work-Book. Designed by H. W. Marsh. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 3*s*. net.

Der Gerbstoffe: Botanisch-chemische Monographie der Tannide. By Dr. J. Dekker. Pp. xiii+636. (Berlin: Gebrüder Borntraeger.) 20 marks.

Prehistoric Times. By the late Rt. Hon. Lord Avebury. Seventh edition, thoroughly revised. Pp. 623. (London: Williams and Norgate.) 10*s*. 6*d*. net.

The British Journal Photographic Almanac, 1914. Edited by G. E. Brown. Pp. 1496. (London: H. Greenwood and Co.) 1*s*. 6*d*. net.

Traité de Géographie Physique. By Prof. E. de Martonne. Deux. édition. Pp. xi+922. (Paris: A. Colin.) 22 francs.

The Sampling and Assay of the Precious Metals. By E. A. Smith. Pp. xv+460. (London: C. Griffin and Co., Ltd.) 15*s*. net.

Photo-Electricity: the Liberation of Electrons by Light. By Dr. H. S. Allen. Pp. 219. (London: Longmans and Co.) 7s. 6d. net.

Modern Seismology. By G. W. Walker. Pp. xii+88+plates. (London: Longmans and Co.) 5s. net.

Heredity and Sex. By Prof. T. H. Morgan. Pp. ix+282. (London: Oxford University Press.) 7s. 6d. net.

The Life of the Mollusca. By B. B. Woodward. Pp. xi+158+xxxii plates. (London: Methuen and Co., Ltd.) 6s.

Ordnance Survey. Professional Papers. New series. No. 2, An Investigation into the Accuracy of the Principal Triangulation of the United Kingdom. By Capt. H. St. J. L. Winterbotham. Pp. 20+v plates. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2s.

Rays of Positive Electricity and their Application to Chemical Analyses. By Sir J. J. Thomson. Pp. vi+132. (London: Longmans and Co.) 5s. net.

Plant Physiology. By Dr. L. Jost. Authorised English translation by R. J. Harvey Gibson. Supplement incorporating the alterations of the second edition of the German original. Pp. 168. (Oxford: Clarendon Press.) 2s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 11.

ROYAL SOCIETY, at 4.30.—Intermittent Vision: A. Mallock.—Attempts to Observe the Production of Neon or Helium by Electrical Discharge: Hon. R. J. Strutt.—The Relations between the Crystal-symmetry of the Simpler Organic Compounds and their Molecular Constitution: W. Wahl.—The Selective Absorption of Ketones: Prof. G. G. Henderson and I. M. Heilbron.—Absolute Measurements of a Resistance by a Method based on that of Lorenz: F. E. Smith.—A Determination of the Electromotive Force of the Weston Normal Cell in Semi-absolute Volts. (With a Preface by Prof. H. L. Callendar, F.R.S.): A. N. Shaw.—Elastic Hysteresis in Steel: F. E. Rowett.—A Simple Form of Micro-balance for Determining the Densities of Small Quantities of Gases: F. W. Aston.—A Second Spectrum of Neon: T. R. Merton.

MATHEMATICAL SOCIETY, at 5.30.—The Linear Integral Equation: Prof. E. W. Hobson.—Generalised Hermite Functions and their Connection with the Bessel Functions: H. E. J. Curzon.—Limiting Forms of Long Period Tides: J. Proudman.—The Number of Primes of Same Residuacity: Lieut.-Col. Cunningham.—Some Results on the Form Near Infinity of Real Continuous Solutions of a Certain Type of Second Order Differential Equations: R. H. Fowler.—The Potential of a Homogeneous Convex Body and the Direct Integration of the Potential of an Ellipsoid: S. Brodetsky.—The Dynamical Theory of the Tides in a Polar Basin: G. R. Goldsbrough.—Proof of the Complementary Theorem: Prof. J. C. Fields.

CONCRETE INSTITUTE, at 7.30.—Some Fallacies in Testing Cement: L. Gadd.

ROYAL SOCIETY OF ARTS, at 4.30.—The Cultivation and Manufacture of Indian Indigo: Prof. W. P. Bloxam.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Continuation of Discussion on Dr. Klingenberg's Address on "Electricity Supply in Large Cities."

FRIDAY, DECEMBER 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The "Kinetic Theory" of Star Clusters: J. H. Jeans.—Distribution of Sun-spots in Heliographic Latitude, 1874–1913: F. W. Maunder.—Results of Micrometer Measures of Double Stars made with the 28-inch Refractor at the Royal Observatory, Greenwich, in the Year 1912: Royal Observatory, Greenwich.—*Probable Papers:* An Explanation of Sun-spots, of the Fluctuations of the Moon's Motion, and some other Puzzles of the Solar System: H. H. Turner.—The Spectra of the Wolf-Rayet Stars: J. W. Nicholson.—The Equatorial Current of Jupiter: Rev. T. E. R. Phillips.

MALACOLOGICAL SOCIETY, at 8.—Descriptions of Various New Species of Mollusca: G. B. Sowerby.—Synonymy of the Family Veneridæ: A. J. Jukes-Browne.—Descriptions of New Species of Land and Marine Shells from the Montebello Islands, Western Australia: H. B. Preston.

ALCHEMICAL SOCIETY, at 8.15.—Alchemy in China: Prof. H. Chatley.

MONDAY, DECEMBER 15.

ROYAL SOCIETY OF ARTS, at 8.—The Measurement of Stresses in Materials and Structures: Prof. E. G. Coker.

TUESDAY, DECEMBER 16.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—A Rough Survey of the Tribes of Western Papua: W. Beaver.—The Nomenclature of Clans in the Pueblo Area: Miss B. Freire Marreco.—Arctic Hysteria in Northern Asia: Miss M. A. Czaplicka.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Further Explorations in the N.W. Amazons Valley: Dr. Hamilton Rice.

ROYAL STATISTICAL SOCIETY, at 5.—Cooperative Live Stock Insurance in England and Wales: Sir James Wilson.—Some Material for a Study of Trade Fluctuations: D. H. Robertson.—The Determination of Size of Family, and Incidence of Characters in Orders of Birth from Samples: M. Greenwood and G. Udny Yule.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Some Problems in Daylight Illumination, with Special Reference to School Planning: P. J. Waldram.

INSTITUTION OF CIVIL ENGINEERS at 8.—Cyclical Changes of Temperature in a Gas-engine Cylinder: Prof. E. G. Coker and W. A. Scoble.

WEDNESDAY, DECEMBER 17.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Great Rain Storm at Doncaster, September 17: R. C. Mossman and C. Salter.—Recent Studies of Snow in the United States: Dr. J. E. Church, Jun.—The Meteorological Conditions of an Ice-Sheet, and their Bearing on the Desiccation of the Globe: C. E. P. Brooks.

AËRONAUTICAL SOCIETY, at 8.30.—The Science of Fast Flying: C. T. Weymann.

ROYAL SOCIETY OF ARTS, at 8.—The Channel Tunnel: A. Fell.

GEOLOGICAL SOCIETY, at 8.—Supplementary Note on the Discovery of a Palæolithic Human Skull and Mandible at Piltdown (Sussex): C. Dawson and Dr. A. Smith Woodward.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Binocular Microscopes of the Past and a New Form of the Instrument: Conrad Beck.

THURSDAY, DECEMBER 18.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Employment of Power in H.M. Post Office: H. C. Gunton.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Standardising of Colours and Symbols representing Geographical Data, especially on Small Scale Maps: Prof. A. J. Herbertson.

LINNEAN SOCIETY, at 8.—The Evolution of the Inflorescence: J. Parkin.—*Hypericum desetangsii*, Lamotte, a New British Plant: C. E. Salmon.—The Mouth-parts and Mechanism of Sucking in *Schizoneura lanigera*: J. Davidson.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, DECEMBER 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Mechanical Engineering Aspects of Road Construction: Col. R. E. B. Crompton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Air-filtration and the Cooling and Ventilation of Electrical Machines: W. E. Gurry.

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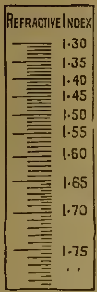

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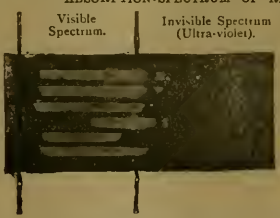

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2303, Vol. 92] THURSDAY, DECEMBER 18, 1913 [Price Sixpence

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THURSDAY, DECEMBER 18, 1913.

PRINCIPLES OF MATHEMATICS.

Principia Mathematica. By Dr. A. N. Whitehead, F.R.S., and Bertrand Russell, F.R.S. Vol. iii. Pp. x+491. (Cambridge: University Press, 1913.) Price 21*s.* net.

THE third volume of this work has followed very closely upon the second, which was only published last year, and is in every respect a worthy successor to it. It is mainly concerned with the theory of series, which was begun in the second volume, and then proceeds to the theory of measurement. A further and final volume will deal with geometry. To some extent the treatment has been influenced by the coming volume, especially in the section devoted to the theory of measurement. For the same reason, a special section is included, containing the theory of cyclic families, such as the angles about a given point in a given plane.

That the monumental task which the authors have undertaken should already have reached this stage is almost incredible. For they are in effect creating a new science, with a symbolism of its own, quite foreign to mathematics, which develops naturally as the work proceeds. It is scarcely necessary to point out that the Principia does not concern itself with the development of mathematics, as understood by the mathematician, but solely with the logical deduction of the propositions of mathematics from merely logical foundations. It represents, in one aspect, the culmination of the movement, which has swept over mathematics of late years, towards a rigorous examination of its fundamental premises. To such a work there is always the disadvantage inherent in a new symbolism, but a symbolism is essential to its development, and the authors employ the method which inflicts the minimum of labour on the reader: no symbol or abbreviation is employed until it becomes essential, and then its very recurrence fixes it in the mind of the reader.

The general scope of the volume has been indicated already, and it only remains to consider the detailed treatment adopted. Well-ordered series are considered first, as possessing many important properties not shared by series in general. In particular, they obey a process of transfinite induction, which is an extended form of mathematical induction, differing, however, in the fact that it deals with the successors of classes instead of single terms. On the whole, Cantor's treatment is followed closely, but an exception is made in dealing with Zermolo's theorem, and in the cases where Cantor assumes the multiplicative axiom. The writers emphasise the dubious character of much of the ordinary theory of transfinite ordinals, depending on the fact that it is founded on a proposition requiring this axiom. Ordinal numbers are defined as the relation-numbers of well-ordered series, after Cantor, serial numbers being the relation-numbers of series in general. Products of an ordinal number of ordinal numbers are not in general ordinal numbers, although the sums are. The treatment of sums and products contains much new matter. Perhaps the most interesting part of the work is the authors' solution of the paradox proposed by Burali-Forti in 1897, relating to the greatest ordinal number. It appears that in any one type there is no greatest ordinal number, and that all the ordinal numbers of a given type are exceeded by those of higher types.

An important section is concerned with the distinction of finite and infinite as applied to series and ordinals. The distinguishing properties of finite ordinals are then established. It does not appear that a proof can be found of the existence of alephs or ω's with infinite suffixes. For the type increases with each successive existence-theorem, and infinite types appear to have no meaning. The treatment of the theory of ratio and measurement is quite new. The quantities are regarded as "vectors" in a generalised sense, so that ratios can hold between *relations.* The hypothesis that the vectors concerned in any context form a *group* is not prominent. The theory of measurement is a combination of two other theories, one a pure arithmetic of ratios and real numbers, and the other a pure theory of vectors. If the axiom of infinity is assumed, great difficulties in connection with the existence-theorems are avoided. But the authors have endeavoured to get rid of the assumption, for, as they point out, it does not seem proper to make the theory of a simple ratio like $2/3$ depend on the fact that the universe contains an infinite number of objects.

The theory of ratio and measurement is actually the most important part of the volume, but it is impossible in a brief review to do justice to it. Yet it must be said that the publication of this volume is a landmark in the theory, and the authors have earned the sincere thanks of all mathematicians who are interested in the logical foundations of their subject. The printing must have been a peculiarly difficult task, on account of the nature of the symbols, and the Cambridge University Press is to be congratulated on the manner in which this work, like its predecessor, has been produced.

K

NEW BOOKS ON CHEMISTRY.

(1) *Preliminary Chemistry.* By H. W. Bausor. Pp. 106. (London: W. B. Clive, 1913.) Price 1*s.* 6*d.*

(2) *Manual of Qualitative Analysis. Reagent and Combustion Methods.* By W. F. Hoyt. Pp. vi+35. (New York: The Macmillan Co.; London: Macmillan & Co., Ltd., 1913.) Price 1*s.* 3*d.* net.)

(3) *A Course in General Chemistry.* By Prof. W. McPherson and Prof. W. E. Henderson. Pp. viii+556. (Boston and London: Ginn & Co., n.d.) Price 10*s.* 6*d.*

(4) *Treatise on General and Industrial Organic Chemistry.* By Dr. Ettore Molinari. Translated from the second enlarged and revised Italian edition by T. H. Pope. Pp. xix+770. (London: J. & A. Churchill, 1913.) Price 24*s.* net.

(5) *Qualitative Analyse vom Standpunkte der Ionenlehre.* By Dr. W. Böttger. Dritte Auflage. Pp. xvii+565. (Leipzig: W. Engelmann, 1913.) Price 11.20 marks.

(6) *Chemie. Unter Redaktion von E. v. Meyer. Allgemeine Kristallographie und Mineralogie. Unter Redaktion von Fr. Rinne.* Bearbeitet von E. v. Meyer, G. Engler, und L. Wohler, O. Wallach, and others. Pp. xiv+663. (Leipzig und Berlin: B. G. Teubner, 1913.) Price 21 marks.

(1) THE "Preliminary Chemistry" by Mr. Bausor, which is issued by the University Tutorial Press, provides, as the preface states, a course of simple experiments for beginners in chemistry, from which most elementary principles of the science are deduced. There are six chapters dealing with air, water, carbon dioxide and lime, salt and hydrochloric acid, sulphur and its acids, and, finally, carbon and combustion. Each chapter is furnished with a summary, a set of questions, and some practical exercises. The experiments are simple in character so as to be well within the capacity of a schoolboy, and the sequence is so arranged as to illustrate fundamental ideas in a clear and logical fashion. For the most part they run on familiar lines. It may be pointed out that the definition of one term by using another, which is left undefined, does not leave the matter much clearer. "If by its conversion into ice or into vapour a new body had been produced differing in *constitution* from the water, we should no longer have been dealing with a physical change." No doubt the orthodox way of beginning a book on practical chemistry is to direct attention to the fundamental distinction between chemical and physical changes; but is it really essential to start with it? Could not the question be more easily answered after a certain number of chemical changes had been observed?

(2) Mr. Hoyt's manual of qualitative analysis is a small volume of 36 pages. Though small and cheap, it is crammed with facts, so crowded, indeed, that the author has recourse to a kind of shorthand in addition to the ordinary chemical formulæ in order to compress his materials. To take one example, the confirmatory test for iron by the action of potassium hydroxide is expressed thus: conf. $2=\text{sol}+KOH=\text{precip.}$ white to dirty green (if Fe'') or brown (if Fe''').

There are few or no explanations, and the whole compilation is that of a mere mechanical guide-book interspersed with a few moral and practical precepts. No one can grumble with the statement that "most laboratory accidents are avoidable" or the advice to be "cleanly in person and work"; but what precise meaning is conveyed by "Nature thinks in the molecule only, and you should learn to do the same" it is difficult to say. The student is further enjoined to "ask himself constantly what? how? and why?" We can only trust that he will have something more substantial than the manual for supplying the answers.

(3) The course on general chemistry by McPherson and Henderson forms an excellent introduction to a more elaborate study, or, in terms of the usual examination standards, would be a useful text-book for a student at the intermediate stage of his chemistry course.

Although the subjects are treated in an elementary fashion, no facts or theories of real importance are omitted, whilst at the same time the text is not overloaded with the description of an unnecessary number of compounds.

The book is written in a clear and simple style, the illustrations, though not so abundant as are sometimes found in American chemical books for elementary students, are well and neatly drawn, so that all the essential details are apparent, an effect partly due to the excellence of the paper. It has evidently been compiled by thoughtful and experienced teachers, who have spared no trouble in the treatment of their subject. It is, in short, a book that may be safely recommended as a text-book for a first year college course.

(4) Molinari's organic chemistry is mainly descriptive of the organic industries, that is to say, theoretical considerations are largely subordinated to the industrial applications of this branch of the science. For example, *tautomerism* occupies half a page, and *stereoisomerism* five pages, whereas the manufacture of explosives and the sugar industry cover about 40 pages each, the brewing of beer and the gas manufacture extend to more

than 20 pages each, and many other technical processes, such as the manufacture of soap, starch, and paper, are treated in the same detailed fashion. We have no desire to underrate the value of a book which devotes the greater part of its space to technology. On the contrary, the excellent and copious illustrations of plant and machinery, the clear exposition of the processes and the carefully compiled statistics will appeal to many students of organic chemistry, who will look in vain for practical information of this character in the ordinary text-book.

But they must bear in mind that the description of operations, which are often merely mechanical and in no sense chemical, cannot replace the principles of the science, which should be carefully studied and assimilated in advance.

Whilst, therefore, strongly recommending the book to the English student, we must warn him that he cannot afford to neglect the theoretical side, and that details of any technical process, however elaborate, will not make him a technologist. We must also point out that he is placed at some disadvantage by reason of the book having been written by an Italian for Italians. The apparatus and methods of technical analysis are often not those recognised as standard methods in this country. Moreover, the rather indiscriminate mixing of English and foreign weights and measures is a little confusing.

Thus, we are told on page 69 that in desulphurising petroleum 4500 kilos of iron oxide are mixed with 200 tons of petroleum; on page 72 it is stated that the value of Bakoum petroleum is about 7*s.* 2*d.* per quintal; on page 532 the quantity of tar treated in England is given in tons; whilst that of creosote oil extracted from it is put down in hectolitres. Moreover, the ton is the metric ton (1000 kilos) and not the English weight. If, in a future edition, the technology could be edited by the translator and English money, weights, and measures introduced so as to conform with English practice, the utility and interest of the volume for English readers would be greatly enhanced. As it is, the volume is a distinct addition to chemical literature, and the translator, Mr. T. H. Pope, may be congratulated on the ability with which he has carried out a task which must have entailed an enormous amount of assiduous application.

(5) Dr. Böttger's qualitative analysis based on the ionic theory is too well known to need a special notice. The present volume is the third edition. The principal changes are corrections and emendation of the text and the addition of microchemical reactions, which have been specially studied for the new edition by his collaborators, R. Heinze and R. Griessbach. The chapters on oxidation and reduction have been thoroughly revised, and a section on autoxidation has been added.

Qualitative analysis is a branch of practical chemistry which is so frequently presented in the form of small books adapted for examination use, that it is a satisfaction occasionally to meet with one in which the subject is raised to something like its proper dignity; and no justification for such a book is needed. It is interesting, nevertheless, to read Dr. Böttger's apologia; for it expresses views in which many teachers of chemistry will entirely concur. The following is a rough translation:—"The preference for short and elementary text-books, whereby a working mastery of analytical technique can be achieved, stands in direct opposition to the views attached to other branches of study in institutions for higher education and to the system of instruction current in the higher secondary schools. It is obvious that so large a mass of material as that included in analytical chemistry cannot be mastered in the short time devoted to the study of qualitative analysis. But it is unquestionably more important and educative for the beginner to learn to use at the outset a book which may act as a guide in his later researches, even if it involves a little more labour, than to study analysis from elementary books which must fail him when more difficult problems present themselves."

(6) The volume under review is on chemistry and crystallography, and is one of nineteen, which include mathematics, the natural sciences, and medicine. They form together one section of a series, which, when completed, will comprise upwards of sixty volumes dealing with what is termed "Modern Culture."

The present volume contains an account of the development of different branches of chemical science, such as inorganic, organic, and physical chemistry, thermochemistry, photochemistry, electrochemistry, physiological chemistry, agricultural chemistry, and crystallography, all within the space of 650 pages.

The names of the contributors are sufficiently well known in the chemical world to ensure that each subject is adequately treated so far as space permits. E. von Meyer has written a general, historical introduction, and among other writers are Wallach, Luther, Nernst, Le Blanc, Kossel, Witt, &c. Each subject is introduced by a brief historical review, with an account of its later progress and development. The book is, in short, a history of the science brought down to modern times.

It is not quite easy to determine for what class of readers the book is intended. It is far beyond the grasp of the scientific tyro, and a well-informed chemist would probably find little that was new to him. Nevertheless it is not without a certain fascination, if only by the mere perusal of a record which exhibits in a striking manner the wonderful fertility of the science and its extraordinary growth in recent years. Moreover, it is well written, well printed on good paper, and handsomely bound.

Anyone who succeeds in assimilating a fraction of the contents of the other fifty-nine volumes, in addition to this, may indeed claim to have reached a condition of modern culture of unexampled thoroughness. J. B. C.

GAS, LIGHT AND AIR.

(1) *Gas Testing and Air Measurement.* By C. Chandley. Pp. vii + 77. (London: Methuen and Co., Ltd., n.d.) Price 1s. 6d.

(2) *Light, Radiation, and Illumination.* Translated from the German of Paul Högner by Justus Eck. Pp. xii + 88. (London: *The Electrician* Printing and Publishing Co., Ltd., n.d.) Price 6s. net.

(1) THE title of the first of these books is somewhat misleading. In these days of high-pressure gas and the use of burners in which the adjustment of the induced air is of the first importance, it is very natural to suppose that a work entitled "Gas Testing and Air Measurement" has something to do with gas burners. This is not the case. By gas is meant fire-damp in mines, and the air measurement refers to the ordinary practice in mines of measuring the ventilating currents.

The author deals with the indications of the safety lamp as an indicator of the proportion of fire-damp if this is not outside the limits of 2 and 5 or 6 per cent., and of the effect of quantities above the explosive limit in putting out the flame. He does not refer to any of the devices that have been used for showing smaller quantities, as, for instance, Prof. Clowes's hydrogen lamp or Liveing's fire-damp indicator. The book is intended primarily for candidates for certificates under section 15 of the Coal Mines Act, 1911. It should serve this purpose well, as the discussion of the all-important cap of the flame of the safety lamp is very clear; some attention is given to the legal requirements and official regulations relating to coal mines, and the methods used for measuring ventilating currents are very fully explained.

(2) "Light, Radiation, and Illumination" is an admirable exposition of the science which forms the basis of the practice of the illuminating engineer. It is the object of the members of this recently organised profession to apply light so as to obtain economical and satisfactory illumination, and not merely to place so many hundred candle-power of illuminating means in a room or a street. The scheme of the book is not unlike that of Euclid, but using the methods of trigonometry and the calculus and geometrical illustrations of a series of propositions following in logical sequence the demonstrations are as clear as any in Euclid, but the time and space required are vastly less than that which would be necessary with a purely geometrical method.

Beginning with a flat element of surface of a given luminous intensity, the author shows that the light radiated in different directions in space is proportional to the chords of a sphere to which the flat surface is tangent at the element. Then gradually sources of other geometrical forms are considered, and such real sources of light as filaments and arc light carbons. The illumination of surfaces and spaces, the effect of light-coloured walls, the curves of illumination from different sources, the uniformity of illumination with many lamps, and many other branches of the subject are treated fully and convincingly, and numerous tables for facilitating calculations in real cases are found as they are required.

While the forms of the illumination curves given by incandescent electric lamps and three kinds of arc lamps receive their full share of attention, no reference whatever is made to gas lighting. Now that the most beautifully lighted streets in London —Victoria Street, Pall Mall, and other streets in the West End, covering some miles—are lighted by high-pressure incandescent gas, it seems rather an omission not to have any statement even of the nature of the illumination curve of this type of burner. While the publishers may persuade themselves that electric illumination now is, after daylight, the only kind that matters, this is not the fact, and the author might with advantage have given the illumination curve of one type of high-pressure gas burner. In spite, however, of this omission, the book is a splendid example of science applied to an art which has been too long neglected.

OUR BOOKSHELF.

The Place of Climatology in Medicine: being the Samuel Hyde Memorial Lectures, 1913. By Dr. W. Gordon. Pp. v + 62. (London: H. K. Lewis, 1913.) Price 3s. 6d. net.

AT a time when the broad features of the climate of civilised countries are well established through long series of exact observations, it is well to be reminded that an accurate knowledge of the local variations, especially of wind and rainfall, are of vital importance in medical climatology. We have yet to produce properly contoured large-scale maps of climate, even for well-populated districts, and these are necessary for the medical expert in those investigations which are essential if the practising physician is to be enabled to base his prescription of climate upon knowledge rather than hearsay and hypothesis. Dr. Gordon gave a new impetus to such research by his inquiry into the effect of rain-bearing winds upon the prevalence of phthisis, and in these lectures he emphasises the need for further detailed investigations of this character; he instances in particular cancer and rheumatic fever as suitable subjects owing to the considerable local variations which he has observed in the distribution of these diseases. The information to be derived from such researches would be useful to the physician in diagnosis and prognosis, as well as in its more obvious applications.

The main thesis of the lectures is the explanation of the origin of the theory that altitude, *per se*, affected the prevalence of phthisis, and the elucidation of the real factor. If the crude death-rate from phthisis is considered, it appears usually that up to about 5000 feet the disease becomes continuously less prevalent as the height increases. even if only an agricultural population is considered. Dr. Gordon has re-examined the statistics in detail, and has arrived at the conclusion that the decrease is mainly due to the more sheltered situations sought by the mountain-dweller for his habitation. He finds that for places exposed to rain-bearing winds the death-rate may even increase with altitude. The differences in the death-rate between places with different exposures are remarkable; in the Grisons the rate is *three to four times* as great in places exposed to W. winds as in sheltered places, and *two to three times* as great as in places exposed only to E. winds. Such results are of the first importance, and Dr. Gordon is to be congratulated on the success of an arduous piece of research.

E. G.

The "Wellcome" Photographic Exposure Record and Diary, 1914. (London: Burroughs Wellcome and Co., 1913.) Price 1*s*.

This neat, handy, and useful little pocket-book contains the concentrated essence of photographic practice, and anyone who has used it once will no doubt, like the writer, continue to secure it annually. The issue for 1914 does not materially differ from that published last year, except that everything is brought up to date. The great success of the tabloid form of developers, &c., is acknowledged by its most general use, and this issue gives, among others, one illustration of Mr. H. G. Ponting using the "Rytol" developer in the hut at the winter quarters, and another by him of the *Terra Nova* off Cape Evans. The special device attached to the cover, which tells the correct exposure at one turn of the disc and the light tables for each month, and factors for plates, films, &c., are special and valuable features of the publication. Ample space is provided for logging the details of each plate or film exposed, and the usual diary portion obviates the necessity of having to carry any other pocket-book for other memoranda, engagements, &c., Three editions are published, one for the Northern hemisphere, another for the Southern, and a third for the United States. The price of one shilling brings it within the reach of everyone, and the book is well worth the money.

Chemical Technology and Analysis of Oils, Fats, and Waxes. By Dr. J. Lewkowitsch. Fifth edition, entirely re-written and enlarged. Vol. i. Pp. xxiii + 668. (London: Macmillan and Co., Ltd.) Price 25*s*. net.

The well-known work of the late Dr. Lewkowitsch was reviewed at some length in these columns on the appearance of the fourth edition some four years ago (Nature, August 19, 1909). In view of the stage of transition through which the subject of fat analysis is now passing, the author would have preferred to wait a little longer before bringing out the present edition, but the exhaustion of the previous issue precluded further delay.

The arrangement of the subject-matter remains much as before, but its bulk has increased considerably, in spite of every endeavour to compress it and eliminate what has become antiquated. Due note has been made of recent progress in the chemistry and technology of fats and oils, so far as the scope of the present volume allows. Attention may be directed, for instance, to the discussions upon the causes of rancidity, the limitations of colour reactions in the examination of oils, the synthesis of glycerides, the hydrolysis of fats by ferments and by chemical catalysts, and the production of "hardened" or "hydrogenised" fats by the reduction of various oils. In short, there is evidence that the volume has undergone a thorough revision in bringing it up to date.

It is to be hoped that the lamented decease of the author will not necessitate any considerable delay in the completion of the new issue. The work was his *magnum opus*, and will remain a worthy memorial of his industry and knowledge.

The British Empire Universities Modern English Illustrated Dictionary. Revised under the chief editorship of Edward D. Price and Dr. H. Thurston Peck. Pp. lxxx + 1008. (London: The Syndicate Publishing Co., 1914.) Price 20*s*.

The illustrations form a noteworthy characteristic of this dictionary; for, as the title-page states, there are coloured plates, monotones, duograph charts and maps. The dictionary proper is preceded by a number of articles by well-known writers designed to promote the intelligent use of the volume; and at the end of the book are many useful and interesting addenda. The type of the dictionary itself is excellent, making reference to it easy and pleasant. With readers indifferent to the price of books the dictionary is likely to become popular, for it is not only trustworthy and exhaustive, but its handsome appearance will make it an ornament to the library table.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Reflection of Light at the Confines of a Diffusing Medium.

I SUPPOSE that everyone is familiar with the beautifully graded illumination of a paraffin candle, extending downwards from the flame to a distance of several inches. The thing is seen at its best when there is but one candle in an otherwise dark room, and when the eye is protected from the direct light of the flame. And it must often be noticed when a candle is broken across, so that the two portions are held together merely by the wick, that the part below the fracture is much darker than it would otherwise be, and the part above brighter, the contrast between the two being very marked. This effect is naturally attributed to reflection, but it does not at first appear that the cause is adequate, seeing that at perpendicular incidence the reflection at the common surface of wax and air is only about 4 per cent.

A little consideration shows that the efficacy of the reflection depends upon the incidence not being limited to the neighbourhood of the perpendicular. In consequence of diffusion [1] the propagation of light within the wax is not specially along the length of the candle, but somewhat approximately equal in *all* directions. Accordingly at a fracture there is a good deal of "total reflection." The general attenuation downwards is doubtless partly due to defect of transparency, but also, and perhaps more, to the lateral escape of light at the surface of the candle, thereby rendered visible. By hindering this escape the brightly illuminated length may be much increased.

The experiment may be tried by enclosing the candle in a reflecting tubular envelope. I used a square tube composed of four rectangular pieces of mirror glass, 1 in. wide, and 4 or 5 in. long, held together by strips of pasted paper. The tube should be lowered over the candle until the whole of the flame projects, when it will be apparent that the illumination of the candle extends decidedly lower down than before.

In imagination we may get quit of the lateral loss by supposing the diameter of the candle to be increased without limit, the source of light being at the same time extended over the whole of the horizontal plane.

To come to a definite question, we may ask what is the proportion of light reflected when it is incident equally in all directions upon a surface of transition, such as is constituted by the candle fracture. The answer depends upon a suitable integration of Fresnel's expression for the reflection of light of the two polarisations, viz. :—

$$S^2=\frac{\sin^2(\theta-\theta')}{\sin^2(\theta+\theta')},\quad T^2=\frac{\tan^2(\theta-\theta')}{\tan^2(\theta+\theta')}, \quad . \quad . \quad (1)$$

where θ, θ' are the angles of incidence and refraction. We may take first the case where $\theta>\theta'$, that is, when the transition is from the less to the more refractive medium.

The element of solid angle is $2\pi\sin\theta\, d\theta$, and the area of cross-section corresponding to unit area of the refracting surface is $\cos\theta$; so that we have to consider

$$2\int_0^{\frac{1}{2}\pi}\sin\theta\cos\theta\,(S^2 \text{ or } T^2)d\theta, \quad . \quad . \quad . \quad (2)$$

[1] To what is the diffusion due? Actual cavities seem improbable. Is it chemical heterogeneity, or merely varying orientation of chemically homogeneous material operative in virtue of double refraction?

the multiplier being so chosen as to make the integral equal to unity when S^2 or T^2 have that value throughout. The integral could be evaluated analytically, at any rate in the case of S^2, but the result would scarcely repay the trouble. An estimate by quadratures in a particular case will suffice for our purposes, and to this we shall presently return.

In (2) θ varies from 0 to $\frac{1}{2}\pi$ and θ' is always real. If we supppose the passage to be in the other direction, viz. from the more to the less refractive medium, S^2 and T^2. being symmetrical in θ and θ', remain as before, and we have to integrate

$$2\sin\theta'\cos\theta'\,(S^2 \text{ or } T^2)d\theta'.$$

The integral divides itself into two parts, the first form 0 to α, where α is the critical angle corresponding to $\theta=\frac{1}{2}\pi$. In this S^2, T^2 have the values given in (1). The second part of the range from $\theta'=\alpha$ to $\theta'=\frac{1}{2}\pi$ involves "total reflection," so that S^2 and T^2 must be taken equal to unity. Thus altogether we have

$$2\int_0^{\alpha}\sin\theta'\cos\theta'(S^2 \text{ or } T^2)\,d\theta'+2\int_{\alpha}^{\frac{1}{2}\pi}\sin\theta'\cos\theta' d\theta', \quad (3)$$

in which $\sin\alpha=1/\mu$, μ (greater than unity) being the refractive index. In (3)

$$2\sin\theta'\cos\theta' d\theta'=d\sin^2\theta'=\mu^{-2}d\sin^2\theta,$$

and thus—

$$(3)=\mu^{-2}\times(2)+1-\mu^{-2}$$

$$=\frac{1}{\mu^2}\left\{\mu^2-1+\int_0^{\frac{1}{2}\pi}\sin 2\theta\,(S^2 \text{ or } T^2)\,d\theta\right\}, \quad (4)$$

expressing the proportion of the uniformly diffused incident light reflected in this case.

Much the more important part is the light totally reflected. If $\mu=1{\cdot}5$, this amounts to 5/9, or 0·5556.

With the same value μ, I find by Weddle's rule—

$$\int_0^{\frac{1}{2}\pi}\sin 2\theta\,.\,S^2 d\theta=0{\cdot}1460,\qquad \int_0^{\frac{1}{2}\pi}\sin 2\theta\,.\,T^2 d\theta=0{\cdot}0339.$$

Thus for light vibrating perpendicularly to the plane of incidence—

$$(4)=0{\cdot}5556+0{\cdot}0649=0{\cdot}6205;$$

while for light vibrating in the plane of incidence—

$$(4)=0{\cdot}5556+0{\cdot}0151=0{\cdot}5707.$$

The increased reflection due to the diffusion of the light is thus abundantly explained, by far the greater part being due to the total reflection which ensues when the incidence in the denser medium is somewhat oblique.

RAYLEIGH.

The Pressure of Radiation.

THE theory of radiation at present accepted is based on Maxwell's result that the pressure of any component frequency is one-third of its energy density, which appears to result from an assumption analogous to Boyle's law, according to which the excess pressure due to vibration, in the case of a gas, would be one-third of the energy density of the vibration.

Lord Rayleigh (*Phil. Mag.*, 1905) has shown that this cannot be true in the case of a gas, since the vibrations are adiabatic, and Boyle's law does not hold. For a monatomic gas, where the reasoning based on the kinetic theory is fairly certain, he deduces that the excess pressure should be two-thirds of the energy density.

In a recent note on radiation and specific heat (*Phil. Mag.*, October, 1913) I gave an outline of a new theory, showing good agreement with experiment, from which I deduced the result that "the total pressure of full radiation should be one-third of the intrinsic energy density, but this could not be true for the partial pressure of each component taken separately." So many of my correspondents, including Lord Rayleigh, have questioned the grounds of this statement, which is the crux of the whole problem, that it may be of interest to explain my reasons more fully.

Arguing on the analogy of a gas, it is evident that the vibrations of radiation must be regarded as adiabatic, and cannot satisfy $pv=$constant, unless the value of the index γ (the ratio of the total energy $E+pv$ to the intrinsic energy E) is equal to unity, which is impossible. We conclude either that the analogy is false, or that, if the vibrations are adiabatic, the ratio may have different values for different frequencies. Since the index γ is equal to $(E+pv)/E$, it is obvious that, to be consistent, we must have $p=(\gamma-1)E/v$, which agrees with Lord Rayleigh's result for monatomic gases, and may be true generally for the pressure of adiabatic vibrations.

According to my theory, radiation consists of the vibration of equal elementary units (Faraday tubes associated with ionic pairs) each possessing the same angular momentum, but having intrinsic energy proportional to the frequency ν and independent of the temperature T. The pressure is assumed to be equally divided between the molecular units according to the gas law $pv=RT$, because this gives the simplest possible explanation of the exponential term $e^{-b\nu T}$ in the radiation formula as a direct consequence of Carnot's principle, and because equipartition of pressure is the most universal condition of equilibrium in physics.

It follows that the ratio of the pressure to the energy density, denoted by $\gamma-1$, must be of the form T $b\nu$, which is different for different frequencies at the same temperature, but gives the mean value 1/3 for full radiation. The possibility of having different values for this ratio is explained by the fact that the vibrations are adiabatic, and the correction thus introduced into the theory of radiation is in this respect analogous to that introduced by Laplace into the Newtonian theory of the propagation of sound.

The assumption here made admits of a fairly simple experimental test, such as the following. Divide the radiation from a source, such as an arc light, into two parts of different frequencies. Compare the total energies and pressures by suitable means. The ratio of the pressure to the energy should be the same for each part on Maxwell's theory. On my theory, the part of lower frequency should have the higher pressure in a determinate ratio. I hoped to be able to try this crucial test before publishing even an outline of my theory, but the rapid extension of the Imperial College in recent years has left me insufficient leisure for so exacting an experiment, though it might not present serious difficulty to an expert in the measurement of radiation pressure.

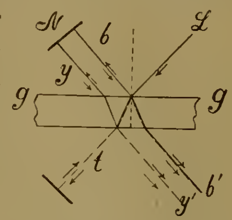
There are many other points in so brief a sketch which may require further elucidation, but these must be postponed. In the meantime I hope I have succeeded in demonstrating at least the possibility, if not the probability, of the fundamental assumption of my theory.

H. L. Callendar.

Imperial College of Science, S.W., December 10.

Scattering in the Case of Regular Reflection from a Transparent Grating: an Analogy to the Reflection of X-Rays from Crystals.

1. *The Phenomenon.*—No doubt the following phenomenon has been noticed before, but I have seen no description of it. If a vertical sheet of white light L from a collimator is reflected from the two faces of a plateglass grating, having about 10,000 or more lines to the inch, g being the ruled face, the two beams b and y going to the opaque mirror N are respectively vividly blue and brownish-yellow. In other words, more blue light is regularly reflected from the ruled surface than is transmitted, and more reddish light transmitted than is reflected. Since the plate grating is not quite plane parallel, two of the four rays, b^1 and y^1, are seen in the same colours in the telescope. This is a great convenience in adjusting the displacement interferometer, where the spectra from b alone are wanted, and the y ray may be screened off at N, while the other y^1 has no spectrum.



The transmitted rays, t, after reflection show very little difference, the one reflected at g being perhaps slightly yellowish as compared with the other.

The spectra from b and y, if compared one above the other, are practically identical. The difference is not sufficiently marked to be discerned by the eye. Multiple reflection from the two faces gave no further results.

Finally, to be coloured blue, the beam must be reflected from the air side and not from the glass side, where but little appreciable effect is produced. If the grating is turned 180°, both the b and y rays are nearly white, while the t rays now correspond to the b and y rays, and are vividly coloured.

Outside the ruled surface and with any ordinary unruled plate of glass, all images are, of course, white. I mention this merely since one might suppose the absorption or colour of the glass to have something to do with the experiment. The film grating, where sharp reflection takes place from the glass and not appreciably from the film, does not show the phenomenon.

2. *Explanation.*—Scattering is usually and perhaps essentially associated with diffuse reflection. The present phenomenon, however, is strictly regular reflection—*i.e.* there is a wave front, for the blue and yellow slit images are absolutely sharp in the telescope. This is the interesting feature of the phenomenon, which associates it at once with the recent famous discovery of Friedrich, Knipping, and Laue relative to the reflection of X-rays from the molecules of crystals, and it is for this reason that I direct attention to it.

In case of the grating the sources of scattered light waves are not only identical as to phase, but these sources are at the same time equidistant. Hence collectively they must determine a wave front of somewhat inferior intensity, but otherwise identical with the wave front of normally reflected or diffracted light—*i.e.* the wave fronts of regularly reflected and scattered light are superposed.

Moreover, if the grating is turned in azimuth even as much as 45° on either side of the impinging beam (after which the many reflections and diffractions seriously overlap), the blue and brown colorations are distinctly intensified. This also is in accordance with anticipations; for the number of lines which are comprehended within the lateral extent s of the narrow beam L, as the angle of incidence i is varied, increases as $s \sec i$; whereas the lateral extent of the reflected beam is no larger than that of the impinging beam. Hence there should be increased intensity of scattered light in the ratio of $\sec i$, or increasing markedly with i from 1 for $i=0°$, to ∞ for $i=90°$. In other words, the scattering lines of the grating are virtually more densely disseminated when i increases.

For the case of light reflected from the inside of the glass plate the evidence to be obtained from colour is too vague to admit of definite statements. I have not therefore attempted it.

Brown University, Providence, U.S.A.

CARL BARUS.

Fractured Flints from Selsey.

I AM astonished to read in the abstract of the Proceedings of the Geological Society of London, No. 947, giving an account of the meeting held on November 19, 1913, the following statement:—

"Prof. Sollas exhibited a series of specimens to illustrate the production of 'rostro-carinate' forms of flint by natural agencies. . . . The great majority were obtained by Mr. E. Heron-Allen from the beach of Selsey Bill, and it was to these that attention was especially directed. If they were all of human workmanship—Sir E. Ray Lankester's contention—there would be no difficulty in accounting for the characters which they possess in common."

I do not know whether Prof. Sollas is responsible for these words or not. But, in any case, I must state in the most unqualified way that they contain an assertion which is absolutely contrary to fact. I have never published any "contention" about flints from Selsey Bill, excepting a brief description in my paper in the Phil. Trans., Series B, vol. 202 (read on November 16, 1911), of one large rostro-carinate implement and one large pyramidal hammer-stone from that locality. To this brief description follows the remark: "Other specimens of a less decisive character have been found."

The assertion that it is my contention that any of the flints (much less "all") obtained by Mr. Heron-Allen, which I have examined, excepting the two briefly described by me, are of human workmanship is the creation of Prof. Sollas's imagination. I should be glad if Prof. Sollas would state where and when I have been guilty of the contention which, according to the Geological Society's report of his communication, he does not hesitate to attribute to me. I, of course, do not suppose that Prof. Sollas attributes a rash "contention" to me in order that he may have the satisfaction of showing it to be rash, and such as to render what I really have said unlikely to be well founded. At the same time, I think I am entitled to call upon Prof. Sollas either to cite "chapter and verse" in which I have made the specific contention which he supposes I have made, or to express some regret for a misrepresentation which I can only account for by a regrettable lapse of attention on his part in the conduct of an important scientific discussion.

E. RAY LANKESTER.

December 3.

I HASTEN to express my extreme regret at having attributed to Sir E. Ray Lankester an opinion which he does not hold.

In the quotation he gives from his paper in the Philosophical Transactions, Sir E. Ray Lankester omits the concluding sentence, "I hope to publish figures of the Selsey Bill specimens at no distant date." I understood this (naturally it seems to me) to apply to all the specimens, and thus concluded that the difference between the more and the "less decisive" was not so important as, upon the omission of the concluding sentence, it appears to be.

When I selected from Mr. Heron-Allen's collection some of his best specimens, by no means all, he assured me that they had been examined by Sir E. Ray Lankester, and pronounced by him to be of human workmanship, a judgment which appeared to me so natural and consistent with Sir E. Ray Lankester's point of view that no suspicion of a misunderstanding crossed my mind. Had I been in doubt I should have taken the precaution to ascertain from Sir E. Ray Lankester his opinion beforehand.

I am glad that Sir E. Ray Lankester acquits me of any intentional unfairness. I thought, and still think, that of the alternatives I proposed, the one I unfortunately attributed to him was the more logically defensible, but in this again I may be mistaken.

I have written to the secretary of the Geological Society requesting him to correct my statement and to add an expression of my regret to be published in the Quarterly Journal of the society.

December 7.

W. J. SOLLAS.

The Structure of the Atom.

I CONCUR with Prof. Rutherford (NATURE, December 11, p. 423) that the work by Moseley in the current number of the *Philosophical Magazine*, which was not published, and was quite unknown to me when I wrote my letter (NATURE, December 4, p. 399), is an important independent confirmation by new physical methods of van der Broek's suggestion. As, however, in a paper published eight months previously (*Jahr. Radioaktivität und Elektronik.*, 1913, x., 193), I had represented in a diagram the places in the periodic table from uranium to thallium, with the mass as the ordinate and the charge as the abscissa, showing that there is unit difference of charge between successive places, I wish to take exception to Prof. Rutherford's statement "that the strongest and most convincing evidence" in support of van der Broek's hypothesis will be found in Moseley's paper. The view had already been far more simply and convincingly established from the chemical examination of the properties of the radio-elements, notably by A. Fleck in this laboratory. Moseley's conclusions are a welcome confirmation, by an independent method, for another part of the periodic table. It can only be described as the strongest and most convincing evidence if the prior chemical evidence is altogether ignored.

FREDERICK SODDY.

Physical Chemistry Laboratory, University of Glasgow, December 12.

The Occurrence of Pilchards in the Eastern Half of the English Channel.

IT is now generally recognised by those who have been interested in the question, that the inshore migration of pilchards in the western fishery area during the summer and autumn of the present year, has presented certain features, which may possibly be attributed to somewhat unusual conditions of food supply and other determining factors. It is therefore a matter of some importance to note that according to the statement of local fishermen, occasional catches of some thousands of pilchards have been made in drift nets off Brighton, Ramsgate, Deal, &c., for several months past.

In the early part of September we examined at Brighton some specimens taken from a catch of about four thousand, and now within the past fortnight, by the courtesy of Mr. E. W. Cowley, the superintendent of the Brighton Marine Aquarium, we have been enabled to ascertain that the fish were still present in the same area. For according to the statement of this gentleman a catch of three thousand was made by a local drifter about two miles off Brighton on November 27, three specimens of which we examined and found to be males with generative organs in "half-ripe" condition.

HAROLD SWITHINBANK.
G. E. BULLEN.

London, December 10.

THE INTERNATIONAL ASSOCIATION OF CHEMICAL SOCIETIES.

THE science of chemistry has some 20,000 adherents at least. Chemical journals are very numerous, and it would be impossible for any one man to read current chemical literature, were he to read for twenty-four hours a day. The investigations of chemists are published, for the most part, in transactions of chemical societies, and until recently these societies lived apart, having merely a bowing acquaintance with one another. "Union is strength," and in default of union, cooperation lends a strengthening hand. Hence a proposal which originated in the winter of 1910–11 with Profs. Ostwald and Haller to form an association of chemical societies was regarded with favour by the three great chemical societies of London, Berlin, and Paris.

To organise this association, a preliminary meeting was held in Paris in April, 1911, at which were present three Frenchmen, MM. Béhal, Haller, and Hanriot; three Germans, Herren Jacobson, Ostwald, and Wichelhaus; and two Englishmen, Dr. Percy Frankland and Sir William Ramsay, as delegates of the three national societies. It was there resolved that all chemical societies should have the right to demand admission to the association, provided their proceedings were published in a journal; and also that each country should be represented by only one society.

At this meeting, too, questions in regard to which the association might do useful work were indicated. Among these are: Nomenclature and classification of chemical compounds; atomic weights; the unification of the notation of physical constants; the editing of indices and summaries of chemical work; consideration of the possibility of utilising a universal language; unification of the size of pages of chemical literature; means to be taken to prevent the re-publication of papers in different journals; and publication of a complete record of chemistry. Statutes were also drawn up; the object of the association is defined as "forming a link between the chemical societies of the world, which shall deal with questions of general and international importance for chemistry." The constitution of the council is also defined in the statutes; there shall be a president, a vice-president, and a secretary, chosen from the same nation, who shall be an acting committee for the period of one year.

During this preliminary meeting, the chair was occupied by each delegate in succession; but Prof. Ostwald was elected president for the meeting in 1912, Prof. Wichelhaus, vice-president, and Prof. Jacobson secretary.

In April, 1912, the first statutory meeting was held in Berlin. The Swiss Chemical Society had joined in the meantime, and was represented by MM. Fichter, Guye, and Werner; the American Chemical Society, by Prof. W. A. Noyes; and the Russian Chemical Society, by MM. Kurnakow, Tschugaeff, and Walden; while M. Marie represented the Société de Chimie-physique of Paris; Hr. Auerbach, the Bunsen-Gesellschaft; Prof. Cohen the Netherland Chemical Union; Hr. Goldschmidt, the Norwegian; and Hr. Biilmann, the Danish Chemical Society. The Italian societies, although they had applied and been received as members of the association, were unrepresented on this occasion.

At the first meeting in Berlin, Great Britain was chosen as the next place of meeting; and Sir William Ramsay was chosen to be president, Prof. Frankland vice-president, and Prof. Crossley was subsequently appointed secretary.

During the meeting the projects suggested were further discussed, and committees were appointed to consider and report on nomenclature, on abbreviated titles for chemical journals, on the size of pages of journals, and on means to overcome the difficulties caused by a multiplicity of languages. It was also announced that the chemical societies of Madrid and of Tokyo, and the Union of Austrian Chemists had applied for admission to the Association. It was arranged that the meeting in 1913 should take place in England in August or September, so as to suit the convenience of American chemists.

This resolve, however, was changed, for the following reason. M. Ernest Solvay, the great Belgian chemical manufacturer, declared his intention of assisting this international movement by a large donation. Hitherto, the expenses had been defrayed by the participating societies. But M. Solvay informed the officers that he wished to place unreservedly at the disposal of the association a sum of 250,000 francs, and that he desired also to set apart a sum of 1,000,000 francs, under such conditions that the capital would be exhausted in twenty-nine years. He ear-marked one-third of the interest of this sum to be devoted to scholarships for Belgian students, while the remaining two-thirds were to be placed at the disposal of the association. This fund is to be administered by a commission, consisting so far as the scholarships are concerned, of M. Solvay himself, or his nominee; of a member nominated by H.M. the King of the Belgians; and lastly, by a member nominated by the University of Brussels. These members, together with three representatives of the council of the association, viz., MM. Haller and Ostwald, and Sir W. Ramsay, are directors of an "International Institute of Chemistry." M. Solvay also signified his intention to provide the association with a secretariat at Brussels, which should serve as a permanent abode.

It was therefore thought advisable to abandon the intention of meeting in England, and to hold the meeting for 1913 in Brussels, so as to have an opportunity of thanking Monsieur Solvay for his generous gift. A further reason for meeting in Brussels lay in the fact that the days appointed coincided with the date of M. Solvay's golden wedding, as well as the fiftieth anniversary of the foundation of the industry which bears his name. The date was accordingly September 19 to 23.

At this meeting the Chemical Society of Belgium was represented; there were present besides delegates from Germany, England, Austria, Denmark, Spain, France, Holland, Italy, Norway, Russia, and Switzerland; the United States and Japan were unrepresented. In all, seventeen chemical societies are affiliated to the international association, representing nearly 20,000 members. Much valuable assistance was received from M. Tassel and from M. Heger in arranging for the meetings.

It was agreed that the place of meeting for 1914 should be Paris, with M. Haller as president. The business done at the Brussels meeting was satisfactory; steps were taken to affiliate the committee on atomic weights; to unify the methods of abbreviating the names of journals; to secure publication of important memoirs which have appeared in one of the less known languages in English, French, or German; to open negotiations to diminish the multiplicity of abstracts, by cooperation among the various bodies which publish extracts; and some important resolutions dealing with nomenclature, and with symbols for physical constants, were adopted.

The need of such an association has now been amply shown. Much can be done to simplify methods, and, by cooperation, to diminish labour, and increase convenience. There is still much to be done, however, and the usefulness of the association will doubtless survive the period at which Monsieur Solvay's gift will be exhausted. The assembling of chemists from various nations, with free interchange of ideas, cannot fail to stimulate all working at the science of chemistry, and cannot fail to promote cordial international relations. "La Science est sans patrie!"

WILLIAM RAMSAY.

HEALTH IN INDIA.

UNDER the title, "A Modern Miracle," *The Pioneer Mail* of September 12 gives some striking figures of the improvement of health among the European troops in India—these figures being taken from the Army Medical Report for last year. With a strength of more than 71,000 British troops in India, there were positively only 328 deaths during the year, equal to 4·62 per 1000. This is really a remarkable achievement; and the smallness of the death-rate is not due in any way to an increase in the invaliding to England—as shown by the fact that the invaliding also fell markedly during the year to 6·68 per 1000, compared with 23 per 1000 in 1892. These are by far the lowest rates on record, and are comparable with the great decrease in the death-rate and the invaliding among non-native officials in West Africa, as disclosed by recent Colonial Office Reports.

Enteric fever, which was once such a terrible pest in India, has now decreased so much that there were only 118 admissions to hospital for it among the whole British garrison. This is undoubtedly due partly to the very great care now exercised in dealing with potential carriers of the disease, both human carriers and flies, and also to anti-typhoid inoculation. Malaria also has shown a very marked decrease during the year, though, as *The Pioneer Mail* points out, this may possibly be partly due to the usual fluctuations in the prevalence of the disease caused by variations in climate. Cholera and plague have also diminished.

Those who are interested in the subject would do well to compare with this fine record a remarkable paper by Sir Charles Pardey Lukis, Director-General of the Indian Medical Service, in the October number of *Science Progress*, entitled "The Sanitary Awakening of India." Sir Pardey Lukis describes the whole position of sanitation in India, and also the very extensive advances which are now being made in the investigation of disease, and the practical application of preventive measures there. Since he has occupied his important post, energy has been redoubled in all these directions. The whole Indian Medical Service, and the Officers of the Royal Army Medical Corps now serving in India, must all be heartily congratulated for the splendid work which they are now doing. Of course, there are ideals still before us; but the old apathy which used to exist in many quarters seems now to be a thing of the past.

Vaccination in India is also doing extremely well. Nearly two million vaccinations were performed in the Bengal Presidency alone during 1912–13, and the total number of deaths from smallpox in that Presidency during the year was only 0·21 per thousand of the population—a very good figure for a country where vaccination has been much opposed on account of "religious" scruples. The lanoline lymph, which I believe was originally invented by Colonel King, is principally responsible for this good state of affairs, and Colonel King is to be much congratulated upon it.

RONALD ROSS.

THE PROBLEM OF THE UNIVERSITY OF LONDON.

SINCE the article in our issue of December 11 was written, further events of importance have taken place. We referred in that article to the proposal of the Higher Education Sub-Committee of the London County Council to recommend the London County Council to invite the Senate of the University of London to express approval of Somerset House as a place for the further development of the University. The recommendation in favour of this site was adopted by the Council at Tuesday's meeting, after discussion. The Council agreed, without a division, to an amendment proposing that, if the Government could not consent to the Somerset House suggestion, the Education Committee should be instructed to report on the proposal to establish the university on a site on the south bank of the river, "where it would form an important feature in the beautifying of London." This proposal has something to be said for it from the point of view of the improvement of the amenities of London, but from the point of view of university policy it has nothing to commend it. If the south side of the river were chosen, nothing whatever would be achieved beyond the possible erection of a fine building for the university offices. No concentration of teaching institutions could possibly take place there, and, consequently, no university quarter could be created. The establishment of a university quarter is of the essence of the matter.

The speech of the Minister for Education at the Birkbeck College on December 10 further strengthens the view that the Government is in earnest in carrying through this important educational reform. The Minister dealt on that occasion with the recommendation of the Royal Commission for the establishment of an evening constituent university college by the development and re-organisation of the Birkbeck College. With this proposal we are in full sympathy.

Considerable care will be required in dealing with the question of the continuation of the external degree. Signs are not wanting to indicate that some members of the external party conceive that their future would lie in some kind of alliance with those institutions that are not accepted as constituent colleges. Such a device would merely set up a sort of second, and inferior, internal side. The only justification for the continuance of the external degree is that it should be truly and genuinely *external*. Every care must be taken in the efforts that are being made to secure agreement not to destroy the well-thought-out proposals of the commission. No one would think of instituting an external side at the present time; it exists and appeals, apparently, to a large number of people. If it is to be continued, it should be as a purely external and impartial examining board, unconnected with any particular educational institution.

NOTES.

The President of the Board of Education has promoted Mr. G. W. Lamplugh, F.R.S., to the post of assistant director of the Geological Survey of Great Britain, and Mr. T. C. Cantrill to that of district geologist, the appointments to take effect on January 6, 1914.

We notice with much regret the announcement of the death on December 15, at thirty-eight years of age, of Dr. P. V. Bevan, professor of physics at the Royal Holloway College, and formerly demonstrator in physics in the Cavendish Laboratory, Cambridge.

Dr. R. R. Gates has received from the Royal College of Science, South Kensington, the Huxley gold medal and prize for research in biology.

A Reuter message from Melbourne on December 15 states that the steamer *Pacifique*, which has arrived at Noumea, reports that the volcano in Ambrym Island, one of the New Hebrides, has for many days been in active eruption. On December 6 six new craters were formed on the west coast, and on the following day Mount Minnie collapsed in the centre.

The Board of Agriculture and Fisheries is engaged in an inquiry, through its horticulture branch, into the failure of fruit-trees to set properly through insufficient pollination. The Board will be glad to be put in communication with the occupier of any orchard of five acres and upward who has reason to believe that his trees are bearing less than the normal crop over a series of years. Fruit-growers who are planting new orchards are also invited to communicate with the Board.

The Italian Meteorological Society has decided to arrange an international congress to be held in Venice in September next. Prominence is to be given to the discussion of problems in connection with the higher atmosphere, and there are to be sections concerned particularly with climatology, aërology, and pure and maritime meteorology. The price of a member's ticket is to be 10 lire, and special railway facilities are to be offered to those attending the congress. All inquiries and applications should be addressed to the general secretary, Barene Emile D. Henning O'Carrel, director of the Patriarchal Observatory in Venice.

At a meeting of the executive committee of the British Science Guild held on December 9, it was announced that a permanent paid secretary had been appointed. It was resolved to support the movement which is being taken to induce the British Government to be represented officially at the San Francisco Exposition of 1915. Lord Sydenham, Sir Francis Laking, Sir John Cockburn, and others were added to the medical committee, and it was decided that the subject of reference to the Royal Commission of which Lord Sydenham is chairman should be considered by the medical committee. The subject of the charges made by the Postmaster-General to persons using the wireless time-signals sent out from the Eiffel Tower in Paris has been considered by the committee on the synchronisation of clocks, and it was resolved to approach the Government upon the subject.

By the regulations for the protection of wild birds and mammals in Egypt, referred to by Sir H. H. Johnston at the end of his article in last week's Nature, the following kinds of birds useful to agriculture are not allowed to be shot, captured, destroyed, exposed for sale, sold, or purchased:—Egrets, larks, pipits, wagtails, warblers, wheatears, flycatchers, orioles, bee-eaters, hoopoes, green plovers, spur-winged plovers, and winged plovers. Permission to collect or keep any of these birds for scientific purposes rests with the discretion of the Minister of Public Works. All shooting is forbidden on Lake Menzala, and gazelles are protected in certain districts. Governors of cities and Mudirs of provinces have the right to refuse to issue game licences, should they see fit to do so, and to make regulations within the limits of their jurisdiction concerning close seasons, reserves, the kinds of animals that may be shot, and special conditions. The virtual effect of the proclamation is that henceforth the killing of any bird but a hawk, kite, or crow is illegal throughout the Khediviate. It is most satisfactory to note that the Egyptian Government protects by these regulations not only the birds of Egypt, but also the rarer mammals. Its example should at once be followed in British India, in British Guiana, and in British Honduras.

Mr. Hugh Phillips, The Manor House, Hitchin, Hertfordshire, stated in *The Times* of December 4 that Newton's house in St. Martin's Street, W.C., was being taken down carefully, after every detail of its construction had been noted and a plan of the structure made by a firm of London architects, with the view of re-erecting the house elsewhere at some future date. In reply to an inquiry, he informs us that at present he has not been successful in finding anyone who will help him to re-erect the house. He says:—"It would be necessary to spend about 10,000*l.* to rebuild and endow it as a museum, and this sum would pay for its upkeep, and its interest would leave a small annual purchasing fund for the acquisition of relics of Sir Isaac Newton and the other inhabitants of the house."

The Russian Supplement of *The Times* for December 15 contains an account of M. Vilkitski's exploration with the ice-breakers *Taimyr* and *Vaigatz*. On the outward voyage, as the vessels were sailing westwards, a new island some miles in circumference was discovered south-east of New Siberia. Nothing was seen of Sannikof Land. About thirty nautical miles north-east of Cape Cheliuskin the expedition found a new island, free of ice, lying along the parallel. Its eastern end was seven miles broad. Thirty miles from the eastern point of this island land was again sighted on September 3, and the explorers reached the shore at lat. 80° 4′ N., and long. 97° 12′ E. They raised the Russian flag and gave to the newly discovered land the name of the Emperor Nicholas II. It is of volcanic origin, is lofty, and contains extensive glaciers. The coast was then traced north-westwards for a distance of twenty miles up to lat. 80° N., long. 96° E., when further progress was stopped by compact ice. On the way back the expedition called at Bennett Island, raised a monument to Baron von Toll, and took on board his collections, weighing 242 lb. The same publication reports the discovery of prehistoric remains on the shores of Lake Baikal, opposite Olkhon Island. Here M. Petri found eleven successive abodes of primitive man. Flint implements occurred in the lowest layer, and in the higher pottery, with designs becoming more artistic towards the upper levels.

A provisional committee, formed of representatives of the Illuminating Engineering Society, the Institution of Electrical Engineers, the Institution of Gas Engineers, and the National Physical Laboratory, held a meeting on November 29 at which arrangements were made for the formation of a National Illumination Committee, to be constituted according to the statutes of the International Illumination Commission, with the primary object of affiliating Great Britain to that commission. The provisional committee recommended that the National Committee should consist of five representatives of each of the three technical societies, and two representatives of the National Physical Laboratory. This recommendation has been adopted, and the following have been nominated as members of the committee:—By the Illuminating Engineering Society: Mr. Leon Gaster, Mr. F. W. Goodenough, Prof. Silvanus P. Thompson, and Mr. A. P. Trotter (this society has not yet nominated its fifth representative); by the Institution of Electrical Engineers: Mr. F. Bailey, Mr. W. Duddell, Mr. K. Edgcumbe, Mr. Haydn Harrison, and Prof. J. T. Morris; by the Institution of Gas Engineers: Mr. E. Allen, Mr. J. Bond, Mr. W. J. A. Butterfield, Dr. H. G. Colman, and Mr. H. Watson; and by the National Physical Laboratory: Dr. R. T. Glazebrook, C.B., and Mr. C. C. Paterson. The first meeting of this National Committee took place on December 2, when the following were chosen as officers:—*Chairman*, Mr. E. Allen; *Vice-Chairmen*, Mr. W. Duddell and Mr. A. P. Trotter; *Honorary Secretary and Treasurer*, Mr. W. J. A. Butterfield. Great Britain is entitled to two delegates on the executive committee of the International Illumination Commission, and Dr. H. G. Colman and Mr. W. Duddell were accordingly appointed by the committee as the delegates from this country.

Mr. Martin John Sutton, who died on Sunday, December 14, in his sixty-fourth year, was for many years the head of the seed establishment of Messrs. Sutton and Sons, Reading. He was a man of great energy and sound judgment; he had strong convictions and possessed the courage of them. Despite his long connection with the Royal Agricultural Society, on the council of which he served for nearly twenty-five years, he opposed strenuously the proposal to substitute a fixed show at Park Royal for the perambulating show which had done such fine service for agriculture. The event justified his opposition and approved his foresight. Notwithstanding the imperative claims of his business—claims which he never ignored—Mr. Sutton found time to take a prominent part in the agricultural, educational, and religious life of the country, as well as the civic life of his native town. Soon after the establishment of the college at Reading he became and remained a member of the council of that institution. He watched its growth with interest, and helped it with generous gifts, but not a few of those engaged in research in Reading count the kindly help and wise counsel which he bestowed so unstintingly among the greater of his gifts to the college. Like his co-partners and his successors, Mr. Martin John Sutton was willing always to place the vast resources of the Reading house and trial grounds at the disposal of those engaged in the investigation of plants and their uses. Mr. Sutton published several important papers on scientific subjects, and his volume on "Permanent and Temporary Pastures," which is a standard work, shows the great amount of exact and strictly scientific knowledge which may be amassed by men primarily engaged in business, and leads the merely scientific man to regret that this knowledge is not more often put into general circulation.

Can any evidence be found of a change in the climate of Europe during the last thousand years before the Christian era? This question is discussed in the *Naturwissenschaftliche Wochenschrift* (No. 44, pp. 689–93) by Mr. Ernst H. L. Krause. It has been prompted by the attempt of Sernander and others to prove that the last marked post-glacial change in the climate of Europe, when the mean annual temperature was about 5° C. lower than now, set in about 500 B.C. This era witnessed the Persian invasion of Greece, the return of the Jews from captivity, and some other national movements, which often are consequences of changes in the productiveness of a region. But contemporary writers, in their geographical descriptions, ought to afford some evidence of so considerable a variation of temperature, and on this point Herr Krause states the result of his investigations. Beginning with Homer, whose age probably corresponds with that of the best bronze work in the north (in which Sernander holds that the climate of Stockholm was dry and warm), he finds nothing to imply any difference in the eastern Mediterranean from its present mean temperature. Hesiod's writings (perhaps a century later) afford no hint of any alteration in the seasons, yet they deal with these and their relation to agriculture. Between his days and those of Aristotle, the temperature of Sweden must have fallen five degrees, yet the writings of the latter, though dealing with natural history, afford no sign of such a change. Theophrastus, Aristotle's pupil, writes on botany without giving any hint of such an occurrence. Herr Krause therefore concludes that this hypothesis has no historical basis, and that any slight alteration, if such there be, can be otherwise explained.

We have received a copy of an article by Mr. E. Heller, published in the Smithsonian Miscellaneous Collections, vol. lxi., No. 1, on the northern, or Lado, race of the white rhinoceros (*Rhinoceros simus cottoni*), based on the large series of specimens obtained in the Lado Enclave during the Roosevelt expedition. The author believes that there really is good reason for the name "white" bestowed on the southern race of the species by the Boers. Full details of the distinctive characters of the skull and teeth are given in the article, of which a full summary will be found in *The Field* of November 15.

To *The American Museum Journal* for November Dr. W. D. Matthew contributes an interesting notice of the vertebrate remains found in the well-known asphalt-springs of Rancho-la-Brea, California, which formed during the later part of the Tertiary period a veritable death-trap for the fauna of the adjacent country. Even now, when the springs are comparatively inactive, the animal that sets its foot on the apparently sound but really treacherous ground is as good as lost, but in the Pleistocene matters were ten times worse. Remains of more than fifty species of birds have been identified, and there were probably at least as many mammals. "Wolves, lions [?=pumas], and sabre-toothed tigers, eagles, and vultures are the most common of the remains found; next to them stand the larger Herbivora, bisons, horses, ground-sloths, and larger ruminants and wading-birds; while remains of smaller quadrupeds and perching or ground-birds are comparatively rare. This is a fact of grim significance, for it indicates that the larger quadrupeds, venturing out upon the seemingly solid surface, and caught in the asphalt, served as a bait for animals and birds of prey, luring them from all the country round about, and enticing them within the treacherous clutch of the trap; these in their turn falling victims, served to attract others of their kind."

The latest issue (part 3 of vol. viii.) of Records of the Indian Museum is entirely occupied by reports on the zoological collections made by Mr. S. W. Kemp, assistant-superintendent of the museum, in the course of the punitive expedition against the Abors in 1911–12. One of the most interesting of Mr. Kemp's discoveries in the Abor country—of a species of Peripatus—is not, however, here described. Most of the reports are merely lists of species with exact records of times and places of capture; but several of them are of wider interest. Mr. Ekendranath Ghosh contributes an excellent and well-illustrated paper on the anatomy of slugs of the genera Atopos and Prisma. Mr. B. L. Chandhuri, who describes the fishes, brings an old controversy regarding McClelland's *Barbus spilopholus* to a satisfactory conclusion. And Mr. Kemp, in an interesting account of the river crabs and prawns, reiterates the extraordinary difficulty of dealing with the Potamonidæ in approved systematic fashion. The beautiful plates by A. C. Chowdhary and S. C. Mondul are a prominent feature of the volume.

That much-investigated animal, Amphioxus, still continues to provide material for elaborate anatomical memoirs, and will probably continue to do so for a considerable time. It is certainly very desirable that our knowledge of this most important type, which stands so near to what must have been the origin of the vertebrate series, should be as complete as possible, and two recently published memoirs set an admirable example of thoroughness in dealing with special systems of organs. In the first part of a memoir entitled "Untersuchungen über das Gefässsystem der Fische" (*Mitteilungen aus der Zoologischen Station zu Neapel*, Bd. 21, No. 4, 1913), B. Mozejko demonstrates the existence in Amphioxus of an elaborate subcutaneous blood-vascular system. The other paper referred to is Miss H. L. Kutchin's "Studies on the Peripheral Nervous System of Amphioxus" (Proc. American Academy of Arts and Sciences, vol. xlix., No. 10, 1913), in which the author describes, with great elaboration, the beautiful results obtained by *intra vitam* staining of the peripheral nerves with methylene blue. Both memoirs are admirably illustrated, and in both the amount of detail observed as the result of very skilful technical manipulation is highly remarkable.

An important further contribution to the series of "Studies in Indian Tobaccos" has been published by Gabrielle L. C. Howard, in the Memoirs of the Department of Agriculture in India (vol. vi., No. 3). The author points out that though most of the varieties of tobacco at present grown in India give large yields and are therefore very profitable, the cured leaf produced from them is usually of very poor quality, and is coarse and deficient in texture, flavour, and aroma, hence only available for Indian consumption, and bringing a low price. Improvements in quality of tobacco may be obtained (1) by the discovery of new cultivation methods ensuring a larger yield and a better quality of leaf; (2) by the introduction of improved methods of curing; (3) by the growth of superior kinds. The present paper deals with the third aspect of the question, the immediate problem being the production of a good cigarette tobacco, and details are given of the extensive experiments which have been made in the attempt to build up, by hybridisation, new kinds of tobacco suited to Indian conditions of growth, and possessing the qualities necessary to obtain a better price. The author has made a thorough investigation of inheritance in tobacco, with special reference to the morphological characters which are of economic importance, namely those concerning the habit of the plant and the leaf, but points out that it will probably take some years to obtain a complete knowledge of the subject, which has proved far more complicated than was at first supposed. The paper is illustrated by numerous plates.

The valuable series of reports issued in connection with the Clare Island Survey is now approaching completion. We have just received a copy of the latest issue, No. 64 of the series. This deals with the Foraminifera, and the authors—E. Heron-Allen and A. Earland—are to be complimented on the exhaustive character of their report, which is illustrated on a most liberal scale. Besides being the longest report yet issued in connection with the survey, it is the largest single contribution to the literature of the British Rhizopoda since the publication of Williamson's monograph in 1858, and pending the issue of the new monograph on which the authors are now engaged, the Clare Island report should prove a useful handbook to workers in this order. No fewer than 299 species and varieties are recorded from thirty-seven shore sands and dredgings made in the Clare Island area, a surprising number in view of the general uniformity of depth and bottom conditions reported. Fourteen species and varieties new to science are figured and described in the report, which also records thirty-two other forms for the first time in Great Britain in the recent condition. Many of them are already known in Britain as fossils. Among other outstanding features of the report we notice with pleasure an exhaustive and up-to-date bibliography and an analysis of the important genus Discorbina, which is illustrated by a diagram of the affinities of the principal species. The publication of similar analyses as regards other genera would be of permanent advantage to the science.

The United States Department of Agriculture has sent us the first number of the *Journal of Agricultural Research*, a periodical which will partly supersede the bulletins and circulars hitherto issued by the various bureaus and offices of the Department. The new journal—a large octavo—is well printed and illustrated, affording a worthy channel for the publication of valuable researches. The first number contains three papers. Mr. W. T. Swingle describes *Citrus ichangensis*, a new species from south-western China, which bears a fruit known as the "Ichang lemon"; it is believed that the plant is hardy and might be advantageously introduced into North America. Mr. B. H. Ransom describes in detail *Taenia ovis* (Cobbold), hitherto known only in the cysticercus stage from sheep. The adult tapeworm, now discovered in the dog, is compared with *T. marginata*, and other allied forms. The concluding paper, by F. M. Webster and T. H. Parks, deals with *Agromyza pusilla*, Meigen, the maggot of which mines in the leaves of clovers and many other plants, both in Europe and America.

In the monthly chart of the Indian Ocean issued by the Meteorological Office for December some very interesting notes are given relating to the aurora in both hemispheres, selected from reports contained in ships' logs and other sources. Among the latter some valuable observations by Dr. C. Chree are especially noteworthy. Among these he mentions that in the north the latitude of maximum frequency is believed to vary from 55° in long. 60° W., to fully 75° in long. 90° E.; aurora is seen at least five times as often in the north of Scotland as in the south of England. There seems to be a fairly well-marked eleven year period, closely connected with the sun-spot period. The phenomenon is generally considered to be caused by electric currents in the atmosphere, but opinions differ widely as to the origin of these currents. Some of the best-known recent theories are quoted.

In the Proceedings of the Cambridge Philosophical Society (xvii., 3, 1913) Prof. A. C. Dixon applies integration by parts to several well-known trigonometric expansions in powers of the sine of an angle, and he is thus able to write down the remainders after any number of terms.

In reading a review in the Bulletin of the American Mathematical Society (xix., 10) of Dr. Gerhard Kowalewski's recent Calculus, we find quoted some interesting French verses from which, by counting the letters of the words, the ratio of the circumference to the diameter may be written down to thirty decimals. They are as follows:—

"Que j'aime à faire apprendre un nombre utile aux sages!
Immortel Archimède artiste ingénieur
Qui de ton jugement peut priser la valeur!
Pour moi ton problème eut de pareils avantages."

It is much easier to remember these verses than the numbers, derived from counting the letters, namely—

$$3{\cdot}141592653589793238462643383279.$$

A separate copy has reached us of Prof. Millikan's paper on the elementary electric charge and the Avogadro constant which appeared in *The Physical Review* for August. It deals with an improved series of observations of the atomic charge of electricity by the method of falling oil drops. The improvements consist in a better optical system for observing the rates of fall of the drops, an arrangement for working in air at different pressures not exceeding atmospheric, a better method of eliminating convection in the air, and the use of a more trustworthy value of the viscosity of air. The author also examines the correctness of the assumptions: that the viscosity effect is uninfluenced by the oil drops being charged electrically, that the drops are spheres, and that their density is the same as that of the oil in bulk. Prof. Millikan's final value for the atomic charge of electricity is $4{\cdot}774 \times 10^{-10}$ electrostatic units, the probable error being 1 in 500. From this value of the charge the author calculates the following constants: number of molecules per gram molecule, $6{\cdot}062 \times 10^{23}$; number of gas molecules per cubic centimetre at normal temperature and pressure, $2{\cdot}705 \times 10^{19}$; kinetic energy translation of a molecule at $0°$ C., $5{\cdot}621 \times 10^{-4}$ ergs; coefficient of the absolute temperature in the expression for the energy at any temperature, $2{\cdot}058 \times 10^{-16}$; coefficient of the logarithm in the expression for the entropy according to Boltzmann, $1{\cdot}372 \times 10^{-16}$; mass of the hydrogen atom, $1{\cdot}662 \times 10^{-21} g$; Planck's "quantum" of energy, $6{\cdot}620 \times 10^{-27}$ ergs; constant of the Wien displacement law, 1·447.

At a meeting of the Alchemical Society on December 12 Prof. Herbert Chatley, of Tangshan Engineering College, North China, read a paper dealing with alchemy in China. Views similar to those of the medieval alchemists of Europe had been current, Prof. Chatley said, in China since 500 B.C. or even earlier. The Chinese alchemists regarded gold as the perfect substance, and believed in the possibility of transmuting base metals thereinto. They also agreed with European alchemists in employing bizarre symbols in their writings, in using mercury as the basis in attempting to prepare the philosopher's stone, in believing in the slow natural development of gold from other metals, and in postulating a sexual generation for all things. Many interesting particulars concerning this last tenet of the Chinese alchemists, the doctrine of Yin and Yang, were given, as well as others respecting their views concerning the elixir of life, in the possibility of obtaining which they firmly believed.

Engineering for December 12 contains an illustrated description of the Hamburg-American Co.'s T.S.S. *Konigin Luise*, which is fitted with Föttinger's hydraulic transformer for reducing speed between the turbine and propeller shafts. Sir John H. Biles attended the trials of this vessel, and his report is reproduced in our contemporary. Of special interest in the report is a complete table of comparison of the results for this ship and those for the *Caesarea* (turbine direct-driven) and for the *Normannia* (turbine mechanical-gear). At full power, the steam used per shaft-horse-power per hour, excluding auxiliaries, is 15·1, 12·2, and 12 lb., for the *Caesarea, Normannia,* and *Konigin Luise* respectively; the coal consumption per shaft-horse-power per hour for all purposes, stated in the same order of vessels, is 1·72, 1·34, and 1·31 lb. A special claim for the Föttinger transformer is ease in manœuvring; this claim is fully maintained in Sir J. Biles's report. Thus, in one experiment the engines were running at about 430 starboard and 410 port. In three seconds from delivery of the order the engines were stopped; after an interval of some seconds they were put to full speed astern, and in four seconds from the time the valve was opened the speed was 370 revolutions per minute. The complete time required to stop the ship was 1 minute 17 seconds, and she stopped in about a length and a half. It may be added that the total orders in hand for Föttingen transformers make an aggregate of 245,000 shaft-horse-power, including a 20,000 shaft-horse-power liner, two cruisers of 45,000 and 30,000, and several destroyers, each of 25,000 shaft-horse-power.

We have received a copy of the first number of a new monthly Italian journal devoted to the automobile, under the title, *H. P.* It is excellently printed, copiously illustrated, and contains interesting articles of technical and general interest. Amongst these may be noted a description of the "Fiat" works at Turin, and an article on rubber culture and manufacture. At the present moment no similar journal exists in Italy, and the new venture will doubtless fill a real want.

Messrs. G. Routledge and Sons, Ltd., will publish in January a "Handbook of Photomicrography," by H. Lloyd Hind and W. Brough Randles.

Many old and rare works on mathematics, physics, chemistry, and kindred subjects, including a large collection of works by Newton and de Morgan, are comprised in a catalogue just issued by Messrs. H. Sotheran and Co., 140 Strand, W.C. A number of copies of Newton's "Principia" is included in the list, and we notice particularly a copy of the first edition of that immortal work offered at the price of eighteen guineas.

Messrs. J. and A. Churchill are about to publish the following new books and new editions:—"A Manual for Masons," by Prof. J. A. van der Kloes, revised by A. B. Searle; "Modern Steel Analysis," by J. A. Pickard; "The Story of Plant Life in the British Isles," by A. R. Horwood; "Materia Medica, Pharmacy, Pharmacology, and Therapeutics," by Dr. W. Hale White, thirteenth edition; "Elementary Practical Chemistry," part i., by Dr. Frank Clowes and J. Bernard Coleman, sixth edition; "The Medical Directory, 1914."

OUR ASTRONOMICAL COLUMN.

A Refraction Acting Radially from the Sun.—In the expression for the variation of latitude, a term exists which is independent of the position of the observing station and which has a periodic character. M. L. Courvoisier has suggested that either the sun has an atmosphere which extends to very great distances or that the æther is denser nearer the sun, causing a small refraction in the light of stars, and thus producing this periodic variation in their positions. M. L. Courvoisier's paper, entitled "Ueber systematische Abweichungen der Sternpositionen im Sinne einer jährlichen Refraction" (*K. Sternwarte*, Berlin, No. 15), indicated that many series of observations pointed towards the existence of this refraction varying in amount with the angular separation, according to a formula which he deduced. His observations included a number of stars at different distances, both in right ascension and declination from the sun. The amount of this refraction near the sun he derived from observations of Venus near upper culmination between the years 1858 and 1909. Mr. F. E. Ross points out a correction to Courvoisier's yearly refraction in *Astronomische Nachrichten*, No. 4699, due to the observations of Venus being compared with an ephemeris computed from Leverrier's tables, which, as he says, are in error in a respect important in a discussion of this kind. The result of the correction is greatly to increase the refraction in the neighbourhood of the sun found by Courvoisier.

Researches at the Allegheny Observatory.—No. 4, vol. iii., of the Publications of the Allegheny Observatory contains an account of the orbit of λ Tauri by Prof. Frank Schlesinger. The variable nature of this star was originally discovered by Baxandell in 1848, and it was the second star, Algol being the first, that was recognised as an eclipsing variable. In this research eighty-nine spectrograms of the star were utilised, and from these the definite elements are given in the paper with the velocity curve corresponding to them. Certain residuals indicate the presence of some disturbing element in the system the nature of which is unknown. Mr. Frank C. Jordan, in No. 5 of the Publications, deals with the spectrographic observations of ϕ Persei, a variable which has received considerable attention by a great number of observers. The special character of the spectrum and velocity curve, coupled with the changes which take place in the spectrum of this star at different parts of its orbit, and in its velocity curve in different cycles, presents a problem yet unsolved. Mr. Jordan's investigation adds another research to the star's credit, but he finds that no single orbit or combination of orbits will satisfy the conditions required. In No. 6 of the Publications Mr. A. H. Pfund describes a very satisfactory result to his preliminary thermo-electric measures of stellar radiation. While the conditions under which he had to employ his apparatus were by no means very favourable to secure the best results, yet the magnitudes of the deflections he obtained were very promising. In his paper he describes the general arrangement of the apparatus and the thermal junctions used, and gives the deflections due to Vega, Jupiter, and Altair. Mr. Jordan suggests the desirability of developing thermo junctions of still higher sensitiveness, and galvanometers of greater sensitiveness, and uses them in conjunction with the largest reflectors, so that stars down to even the 4th magnitude may be studied.

Zodiacal Matter and the Solar Constant.—In citing four cases where zones of asteroids have been hypothecated to explain planetary and cometary perturbations and lunar inequalities, Mr. E. Belot, in a note in *Comptes rendus* (No. 18) points out that he published in 1905 a formula to take the place of Bode's law, and that certain of the five zones of asteroids this formula predicts supply just the material in just the right positions. He proceeds further, and makes the suggestion that the transit of these zones across the sun's disc may be found to supply the probable cause of variation of the solar constant established by the work of Abbot, Fowle, and Aldrich.

THE PHYSICAL SOCIETY'S EXHIBITION.

THE ninth annual exhibition of the Physical Society of London was held in the Physical Department of the Imperial College of Science on Tuesday, December 16, and attracted the usual large attendance at both afternoon and evening sessions. In addition to the short discourses which have for some years formed a popular feature of the exhibition, a new departure was made by the introduction of several interesting experiments illustrative of recent research. In the exhibition proper about thirty firms showed their most recent forms of apparatus.

The first discourse was given by Mr. Louis Brennan, C.B., who exhibited and described a simple apparatus for making large soap films, and demonstrated their properties. The film was formed on a frame of elastic which was capable of considerable extension, thus reducing the thickness of the film and showing the consequent change of the colour of the reflected light. The second discourse was by Prof. J. A. Fleming on the vibrations of loaded and unloaded strings. The string was caused to vibrate by means of a motor, to the shaft of which one end was excentrically attached. The tension could be adjusted by moving the pillar to which the other end was fixed. The effect of loading was shown by using strings twisted together, and also by the addition of beads. The reflection which takes place when the wave-length is reduced to the distance between successive beads was clearly shown, as was also the difference between the effect of a single large load and that produced by a load distributed over some distance, gradually increasing in amount and then diminishing. Prof. Fleming pointed out the application of these experiments to the case of the reflection and transmission of light at the boundary of two media, and to the more important case of loaded telephone cables.

Among the experiments already mentioned, Mr. W. E. Curtis exhibited the band spectrum of helium. A vacuum tube at a pressure of several millimetres was excited by an induction coil, a condenser and spark-gap being included in the secondary circuit. With suitable capacity and length of gap, the spectrum shows a number of bands in addition to the ordinary helium lines. An experiment illustrating ionisation by collision was shown by Mr. F. J. Harlow. An electrodeless discharge was excited in a spherical bulb and the pressure reduced. It was found that the discharge could be continued at a much less pressure than usual if heated lime or aluminium phosphate was present to produce ionisation. The phosphorescence of mercury-vapour in a vacuum excited by light from a mercury lamp was exhibited by Mr. F. S. Phillips. Prof. J. T. Morris and Mr. J. F. Forrest showed an electric arc which they suggest for use as a standard of light, the light from the positive crater being quite unobstructed. Messrs. C. C. Paterson and B. P. Dudding had a simple device on exhibition for reducing the glare from motor headlights by confining the light to the region below the horizontal on the right-hand side as seen from the car. An indicator for use with high-speed internal-combustion engines was shown by Dr. W. Watson, and also an arrangement for studying the spectrum of a burning mixture at different stages of the combustion. An experiment on the interference of X-rays by a crystal of rock-salt through which they were passed was shown by Dr. G. W. C. Kaye and Mr. E. A. Owen, the crystal patterns being visible on a fluorescent screen.

There was a large number of interesting features among the exhibits of the firms. The Cambridge Scientific Instrument Co. had on view an electrostatic oscillograph designed by Prof. H. Ho and S. Kotô, of Japan, which possesses important advantages over the electromagnetic oscillograph for high-voltage work. A contact-breaker for physiological work which could successively interrupt two circuits with an intervening period of from 0·0002 second to 0·04 second was also shown. An inexpensive form of independent plug contact for resistance boxes was shown by Messrs. Gambrell Bros. A simple apparatus for measuring the pressure of light, designed by Mr. G. D. West, was exhibited by Messrs. J. J. Griffin and Sons. Mr. R. W. Paul exhibited a large number of electrical laboratory instruments, including a simple device for projecting an image of the scale and pointer of an instrument on a screen for lecture purposes. Among the exhibits of Messrs. Isenthal and Co. was a collection of pladuram products, a form of tungsten specially treated, which it is hoped to apply to purposes where a hard, inert metal is required. Radio-active preparations were shown by Mr. F. Harrison Glew. The principal exhibit of Messrs. Muirhead and Co. was a Heurtley magnifier for use in cable telegraphy or wireless telegraphy, or wherever it is required to magnify the effect of small mechanical movements. Instruments connected with wireless telegraphy were shown by the Marconi Company, the Ludgate Wireless Company, and Messrs. Graham and Latham, while very complete exhibits of projection apparatus and microscopes for all purposes were shown by Messrs. Carl Zeiss, Messrs. E. Leitz, Messrs. Newton and Co., and other firms. The instruments of Messrs. H. Tinsley and Co. for colour measurement and for lens testing, and the new miniature precision instruments of the Weston Co., are also worthy of mention.

THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

THE first International Congress of Tropical Agriculture was held in Paris in 1905, and was organised by a number of French men of science interested in this subject. At its close the Association Scientifique Internationale d'Agronomie Coloniale et Tropicale was founded, to promote in every possible way scientific work in tropical agriculture. Branches of this association were gradually founded in Belgium, France, Germany, Great Britain, Italy, Portugal, and elsewhere, until at present practically every country interested, either on its own account or through its colonies, in tropical agriculture, is represented on the Central Bureau of the association, which has its headquarters in Paris. In 1910 a very successful second Congress of Tropical Agriculture was held in Brussels. At the close of that congress M. de Lanessan, formerly Governor-General of Indo-China, who had up till that time been president of the association, retired, and was succeeded by Prof. Wyndham Dunstan, C.M.G., F.R.S., director of the Imperial Institute.

The International Association has decided to hold the third Congress of Tropical Agriculture in London, at the Imperial Institute, on June 23–30 next year, under the presidency of Prof. Dunstan. A strong organising committee, including Sir D. Prain, director of the Royal Gardens, Kew; Sir S. Stockman, chief veterinary officer to the Board of Agriculture and Fisheries; Mr. Bernard Coventry, Agricultural Adviser to the Government of India; Dr. F. Watts, Imperial Commissioner of Agriculture for the West Indies, and other eminent authorities on tropical agriculture, has been at work for some time in preparation for the congress.

It is proposed to devote the afternoon meetings of the congress to papers, and the morning meetings to a series of discussions on important problems of special interest, such as technical education and research in tropical agriculture; outstanding scientific problems in rubber production; methods of developing cotton cultivation in new countries; problems of fibre production; agriculture in arid regions; and hygiene and preventive medicine, in their relation to tropical agriculture. The organising committee will welcome contributions on these or allied subjects.

For further information regarding the arrangements for the congress, the communication of papers, &c., application should be made to the organising secretaries (Dr. T. A. Henry and Mr. H. Brown), Third International Congress of Tropical Agriculture, Imperial Institute, London, S.W.

PHYSICAL CHEMISTRY OF SOLUTIONS.

AS is well known, the progress in the physical chemistry of solutions which has been made during the last thirty years, though extensive and detailed in a certain sense, has nevertheless suffered not a little from the fact that fully 90 per cent. of the investigations have been restricted to the study of the behaviour of substances dissolved in *water*. At the present time, therefore, whilst a very large amount of data has been accumulated upon the subject of aqueous solutions, our knowledge of the behaviour of non-aqueous solutions and solutions formed in mixed solvents is deplorably scanty. Of course, here and there the subject has been attacked, especially within the last decade, and a few general conclusions have been laboriously attained. Many of the rules, however, which serve as a trustworthy guide in the case of aqueous solutions have to be considerably modified or even discarded altogether when we come to non-aqueous solutions. At the same time, it is clear that the problem of solution in general cannot be regarded as in a satisfactory state, so long as generalisations applicable to a large number of solvents at least are wanting.

It is for this reason that we welcome the monograph published by Prof. H. C. Jones, entitled "The freezing point-lowering, conductivity, and viscosity of solutions of certain electrolytes in water, methyl alcohol, ethyl alcohol, acetone, and glycerol, and in mixtures of these solvents with one another" (Publication No. 180, Carnegie Institution of Washington). The present work is to be regarded as supplementary to Publication No. 80 of the same institution. The actual experimental work has been carried out by several investigators, under the direction of Prof. Jones. Each of these investigators, after giving an account of the experimental methods and results obtained for various salts—inorganic salts—in various solvents, pure and mixed, makes a very brief summary of conclusions, the whole field being finally reviewed by Prof. Jones himself in a general discussion, which occupies the last dozen pages or so of the book. As was to be expected, great stress is laid upon the generality of the phenomenon of solvation and much of the work is devoted to the elucidation—naturally with varying success—of the three fundamental factors:—(1) Change in solvation, which changes the mass and size of the ion; (2) change in the viscosity of the solution with change in temperature thereby affecting the friction of the ions in moving through the solution; and (3) change in the number of dissolved particles—molecules and ions.

The publication as a whole is a monument of industry which reflects the greatest credit upon the laboratory from which it emanates. It is sincerely to be hoped that the systematic accumulation of similar data will become much more general than has hitherto been the case.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THIS has been a year of congresses for physiologists. The International Congress of Medicine, the International Congress of Physiology, and the British Association all took place during August and September. In spite of the fact that the British Association came last, the section of physiology had a very successful meeting.

The president's address was especially interesting, as it gave the views of an organic chemist on the physico-chemical aspect of his work. The address has already appeared in NATURE (October 16, p. 213).

On Monday morning, September 15, the section of physiology held a joint meeting with the section of agriculture. A paper by Prof. Sörensen and a discussion on the physiology of reproduction occupied the attention of the two sections.

Prof. Sörensen dealt with the measurement and the significance of the hydrogen ion concentration in biological processes. He began by pointing out that the hydrogen ion concentration gives more information than the statement of the amount of acid in the solution. Some of the acid may be neutralised or unionised, and hence it does not exert its full acidic power. A similar relation holds between hydroxyl ion concentration and alkalinity.

As the product of hydrogen and hydroxyl ion concentrations is constant at a given temperature, the most convenient method of expressing acidity or alkalinity is in terms of hydrogen ion concentration. Owing to the hydrogen ion concentration in biological processes being very small, he uses the sign p_H to indicate the negative exponent of the normality in respect to hydrogen ions. Thus $2 \times 10^{-6} = 10^{-5 \cdot 69}$; therefore $p_H = 5 \cdot 69$.

The electromotive measurement of hydrogen ions is the standard method, but the colorometric indicator method is more convenient for many purposes.

The use of "buffers," by which acid or alkali formed during a reaction is neutralised without an appreciable change in hydrogen ion concentration, enables one to study the effect of the hydrogen ion concentration on various processes. The cases illustrated were invertase and other enzymes, hæmolysis, and phagocytosis.

The discussion on reproduction was opened by Mr. K. J. J. Mackenzie, who pointed out that the stock-breeder was well trained and ready to absorb sound knowledge, but that the knowledge was not there for him to have. There are many problems of a practical nature and of great financial importance in regard to stock-breeding, but he spoke mainly about two of them.

The first was the problem of the "Free Martin." A heifer born twin to a bull is said to be sterile. Several cases were investigated, and it was found that some were sterile and others fertile. If it could be predicted which are the fertile ones, this knowledge would make a considerable difference to the prices obtained at sales of pedigree stock. Mr. Mackenzie pointed out that twins may result from the fertilisation of two eggs or by the division of one fertilised egg into two individuals. The former would possess two separate amnions, whilst the latter would be contained in a common amnion. Observation at birth of the presence or absence of two amnions and correlation of the observations with the subsequent histories of the offspring might solve the problem which heifers would be fertile. In reply to a question he said that sterility of the bulls was much less important, as they were usually castrated.

The second problem was that of "black belly" in swine. It was considered that this was due to œstrus, and that bacon made from such animals was unwholesome. Investigation showed that the pigmentation is due to skin pigment, and that œstral changes are so slight as to be overlooked in slaughter-houses. If the prejudice to the pigment cannot be overcome, the remedy is to breed swine without mammary pigment.

Problems in milk production and sterility in bulls and stallions were also quoted as subjects requiring investigation.

Mr. Geofrey Smith sent in an abstract dealing with the glycogen and fat metabolism of crabs. The males and females present striking differences. Males have less fat and more glycogen in their livers than do the females. The blood of the male is pink, whilst that of the female is yellow. Infection with sacculina causes disappearance of sexual changes, and the males become like the females in composition.

Dr. L. Doncaster mentioned other cases in which the males and females differ. For instance, in caterpillars, by the precipitin test, the two sexes can be shown to differ more than the same sexes but of different species. He suggested that male and female characters are present in both cases, but that some factor, by influencing metabolism, determines which sex develops. Sacculina apparently causes the same type of metabolism as does the female factor.

A combined meeting with the sections of zoology and botany was held on Tuesday morning, September 16. Prof. B. Moore, F.R.S., gave a communication entitled "Synthesis of Organic Matter by Inorganic Colloids in presence of Sunlight, considered in relation to the Origin of Life."

His view is that the first organisms would not contain chlorophyll, and hence there must have been a supply of organic matter before the organisms could flourish. He demonstrated that from water containing carbon dioxide and colloid, formaldehyde is produced by ultra-violet light.

He then outlined the scheme of development whereby increasing complexity causes instability, and that regions of stability occur by the formation of a new order of substance. As the material becomes more complex, its properties alter. Therefore, although one can trace the relationships from one to another, objects widely separated behave differently.

Æther and energy give rise to the electron, and the electron to the atom. When the atom becomes too large and unstable, the molecule is formed. Combinations occur between molecules by molecular affinities, *e.g.*

$$Na_2SO_4 + 10H_2O \rightleftharpoons Na_2SO_4.10H_2O.$$

Molecular combinations form colloids, which are unstable substances, resembling the instability of living organisms, and finally living cells are formed. Social organisation such as that of the hive bees may be the next step, when the individual has reached its highest possible development.

Sir Oliver Lodge agreed with Prof. Moore that new possibilities enter matter with increase in complexity, and that complexity and instability are necessary for life. He also stated that the synthesis of potentially living matter is not the same as the origin of life.

Prof. Armstrong stated that it is not possible to arrive at the production of life. He gave instances of several other ways in which formaldehyde can be synthesised in the laboratory. He did not consider that colloid was necessary for the synthesis. His opinion is that the asymmetry of the chemical composition of living organisms is the only difficult point to understand, but that once asymmetry has been produced, enzymes can direct the asymmetrical synthesis.

Dr. Hopkins, Prof. Leonard Hill, and Prof. Hartog criticised various points, and agreed with Prof. Armstrong and Sir Oliver Lodge in several of their statements.

Prof. Priestley gave several instances of synthesis of formaldehyde without colloids, but he claimed that colloids were important for energy changes in cells. Sugar can be produced by bubbling carbon dioxide through alkali in the light of a mercury lamp. He suggested that asymmetry might be produced by the action of polarised light which is found in the surface layers of the sea.

Prof. Rothera said that the discussion took two divisions: criticism of details and criticism of generalisations. He believed the sequence outlined in Prof. Moore's statement to be quite correct.

Prof. Moore, in replying, said that he did not claim that the synthesis is new, but he knew that formaldehyde had been produced by ultra-violet light. Prof. Armstrong's examples were mainly reactions, which could be brought about by human agency in the laboratory, but that the conditions were unlikely to occur naturally at an early stage of the world's history. Because Prof. Armstrong has difficulty in understanding the production of asymmetry, this does not obscure the point that energy can be accumulated by synthesis without chlorophyll. The problem of asymmetry would *follow* the production of organic matter.

The new idea is not the synthesis but the point of view, and he considers that under the natural conditions synthesis would be aided by colloids even if the colloid were not absolutely necessary. In many cases, such as synthesis in presence of uranium, colloid would also be present.

Friday, September 12, was devoted to a joint sitting with the subsection of psychology, and the proceedings will be recorded in the report of that subsection.

On one of the reports there was a general discussion, in which Dr. A. D. Waller, F.R.S., Sir Frederic Hewitt, Prof. Gilbert Barling, Dr. McCardie, Mr. F. J. Pearse, Prof. Saundby, and Prof. Vernon Harcourt, F.R.S., took part. These speakers unanimously agreed that there should be some State regulation of anæsthesia.

The present position is that anyone can administer anæsthetics such as chloroform, ether, cocaine, &c., without any restriction. Sir Frederic Hewitt pointed out that a railway accident was followed by an inquiry, but there was no inquiry after a death from anæsthesia. Porters and cloak-room assistants do not drive engines, yet anyone can administer an anæsthetic to another person. The object of this discussion was to urge on the Government the necessity of regulating the administration of anæsthetics. Motions to this effect have been passed by the British Medical Association, the Medico-Legal Society, the International Congress of Medicine, &c.

Dr. Duffield explained the report on calorometric observations on man, by lantern slides illustrating the work done. The carbon dioxide output has been especially studied. During the early stages of work carbon dioxide accumulates in the body, and hence the output rises slowly. At the end of ten minutes the output becomes uniform, showing that the body is sufficiently saturated to give off the carbon dioxide as rapidly as it is formed. After the end of the work the excess of carbon dioxide must escape, and hence there is a slight continuation of the increased output.

Prof. E. Wace Carlier described the histological structure of the post-pericardial body of the skate. It is a small body the size of a grain of rice. The structure resembles that of the carotid gland in mammals, and he considers that it is a chromaffin gland.

Prof. Leonard Hill, F.R.S., gave two communications. The first was a demonstration of his katathermometer, which consists of two thermometers heated to about 120° F. The time necessary for them to cool from 110°–100° F. is recorded; one has a dry bulb and the other has a piece of moist cloth round the bulb. These give an indication of the physical condition of the air, and this physical condition is, in ordinary circumstances, of far greater importance to well being than the presence or absence of respiratory waste products.

His second communication (with Dr. McQueen) was on the pulse and resonance of the tissues. Where the arteries are superficial, the blood pressure, as measured by the sphygmanometer, is lower than where the arteries are surrounded by the tissues. The tissues resonate with the arterial pulsations, and thus the pressure appears higher.

Prof. A. B. Macallum, F.R.S., and Dr. J. B. Colip described the blackening of nerve cells, but not nerve fibres, with silver nitrate. The change is not due to chloride, phosphate, or protein. It is due to some reducing substance which they believe to be an oxyphenol allied to adrenaline. The medulla of the suprarenal bodies gives a similar reaction.

Dr. F. W. Mott, F.R.S., read a paper on the biochemistry of the neurone. He commenced by pointing out that the Nissl granules disappear from the nerve cells of animals fed on white bread and from cells of which the axons have been cut. These appearances can be seen only in fixed cells. Living cells suspended in lymph or cerebro-spinal fluid show no Nissl granules, but the contents appear like an emulsion. With dark ground illumination the emulsion particles appear luminous, but show no brownian movement. No particles are visible in the axon where it is surrounded by the myelin sheath. Dilute ammonia causes the cells to become irregular, the particles to escape, and to show brownian movement. Acids and some dyes cause appearances like Nissl granules.

Cells placed in methylene blue stain but show no granules. If deprived of oxygen, the cells do not stain blue as the leuco base is formed. On allowing oxygen to enter the tube, the cells stain, showing that the leuco base had been absorbed by the cells.

Dr. J. Tait described experiments on blood coagulation, in which he observed agglutination of corpuscles to the edges of the wound in Gammarus and in tadpoles. Some crustacea have blood which does not coagulate, yet hæmorrhage is stopped as rapidly as in those whose blood does coagulate. It is difficult to understand the advantage of coagulable blood.

Dr. J. Tait and Miss Macnaughton demonstrated the advantages of the heart of the hedgehog for perfusion experiments. It can be removed and kept beating by perfusion with Ringer solution at any temperature between that of the body and ordinary room temperature.

Dr. J. Tait and Mr. R. J. S. McDowall: The muscles which extend from the skeleton to the skin of the back of hedgehogs will contract at temperatures from 0°–40° C., and they require no oxygen supply. A muscle placed in a narrow glass tube filled with Ringer's solution will remain active for hours even if repeatedly stimulated.

Dr. Dawson Turner read a paper describing the effect of treating exophthalmic goitre with radium. He found that the treatment was beneficial.

The following three papers are of cognate interest, and they are therefore described together.

Prof. Georges Dreyer and Dr. E. W. Ainley Walker read two papers on the relation of organs to the general body weight. The normal relation is important, as variations are of interest in studying abnormal conditions. These authors find that the relation of the blood volume to body weight is given by the formula: Blood volume $= \frac{(\text{body weight})^n}{K}$, where n and K are constants. For birds and mammals n is approximately 0·72, and for cold-blooded animals n is 1·3. Therefore, for the former, the determining factor is the body surface, and for the latter the weight of the muscles. Similar relations hold for the area of the aorta and of the trachea.

Altitude affects the blood volume by a variation in the constant K. On going to high altitudes the blood volume decreases and the hæmoglobin content increases, pointing to concentration by removal of water. The hæmoglobin is slightly increased after several days, and the blood volume also slightly increases. On returning to lower levels the blood volume rises and the hæmoglobin percentage decreases, but neither returns to its original level until several days later.

Dr. H. E. Roaf found, when the weight of the kidneys is expressed by a similar formula, that n is approximately 1·5, and hence the body surface does not regulate the kidney weight. Possibly there is some reciprocal relation to the skin; or, like the blood volume of cold-blooded animals, the kidneys depend upon the mass of muscle in the body.

In concluding this account of the section of physiology, we feel that some reference should be made to a new feature. The section was strengthened by having associated with it the first subsection of psychology.

H. E. ROAF.

GEODETIC OBSERVATIONS AND THEIR VALUE.[1]

IT is not always the greatest inventions, or those which come most prominently before the public, which effect the greatest revolutions in the field of practical science; it is often the perfecting of instruments that have been long in use which is chiefly responsible for progressive results of startling significance. For instance, in the scientific researches of chemical investigators, or in matters relating to pathology and meteorology, it is seldom that a fresh discovery is due to the invention of a new instrument; it is almost invariably the development of the power of assisting observation already existing in the old instruments which has effected new discoveries. This is peculiarly the case with modern instruments used in connection with geodetic work. It is the perfection with which the metal arc can now be graduated with equal divisions representing degrees, minutes, and seconds which has so greatly altered the conditions under which geodetic triangulation can be extended. The improvements effected in base measuring apparatus is another factor in the rapid evolution of earth measurement and map-making all over the world; whilst the improved pendulum for the registration of the varying force of gravity, corresponding to the varying conditions of density which obtain in the earth's crust, renders investigations into the science of isostasy more simple and more certain than could possibly have been anticipated, say, fifty years ago.

These developments in the processes of advancing the practice of geodetic measurement over the surface of the earth are of more importance than is generally recognised, because the direct connection between geodesy and geography is not rightly understood. Geodesy is not a mere abstract science dealing with the shape of the earth and solving mathematical problems connected with its eccentricity, or determining the variable density of the earth's crust by careful investigations into the force and direction of gravity; it furnishes the basis and the framework of all that extension of earth measurement of which the final outcome is the map. Geodesy offers but little field for such form of illustration as will readily fix it in the minds of men as a sound practical everyday working science essentially necessary for the economic and political advancement of civilisation.

Geodesy began with the measurement of arcs on the earth's surface in various parts of the world by the process of extending a series of triangles along that arc from a measured base at one end of it. Rigorous accuracy was the dominant feature of such measurements. The measurement of a base a mile or so in length was effected formerly by means of "compensation bars" of a given length, which were designed with infinite care and armed with mechanism for longitudinal, vertical, and transverse adjustment, and it was a most elaborate and lengthy process. The process was repeated at intervals, if the triangulation series was a long one, in order to ensure results as near absolute accuracy in linear measurement as was possible. It took months to measure a base. Now it is found that by using a wire composed of "compensating" metals and stretched along a series of cradles or supports, the same result can be obtained in about one-tenth the time. The Jaderin apparatus, which includes a wire 25 metres in length, affords the simplest means of obtaining accurate base measurement; but there is still an appreciable defect, due to varying conditions of temperature, which renders it necessary to compare the wires before and after use with a standard measurement. The Eötvös torsion balance represents, perhaps, the latest improvement in apparatus for the measurement of base lines.

Independently of the base, however, the real secret of the facility with which strictly scientific geodetic triangulation can be carried over large areas of new country lies in the improvement in the art of graduating metal arcs, which has rendered the comparatively light and portable 12-in. theodolite equal for purposes of rigidly accurate observation to the old 2-ft. or 3-ft. instrument of the past. In India, where one of the first and most perfect systems of geodetic triangulation has been carried out, it used to be necessary to call quite a large number of carriers into the field to convey the clumsy old instruments from one observing point to the next. Paths had to be cut with much labour and patience through the jungle; roads had to be smoothed out and carried up the sides of the hills. The expense would have been prohibitive but that labour was cheap in those days. The time occupied over the process of completing observations, even at only one station, frequently lengthened out into months. Nowadays there is a new generation of scientific observers educated in English schools, who need lose no time in carrying first-class work through the wild tangle of African hills and forests to determine a boundary; or in threading their way with infinite patience by the rock-bound defiles and snowy heights of the Himalayas to a junction with Russian Surveys on the Pamirs.

It has always been the aspiration of English surveyors to link up the magnificent survey system of India with that of Russia. To a certain extent this was effected by methods which cannot be accepted as scientifically regular during the progress of the Pamir Boundary Commission in 1895. The surveyors did, however, actually close on a determined point common to both surveys (it was the first boundary pillar at the eastern end of Lake Victoria) after carrying an irregular triangulation across the great snowy ranges of the north-west, and the resulting agreement between the two values was almost too good to be altogether satisfactory. The means did not justify the end. It was impossible to ascend the gigantic peaks of the intervening ranges within the limits of the time available, and it was necessary, therefore, to be content with seeing across them here and there, under specially favourable conditions, instead of observing from them. Lately, however, a more regular and systematic attempt has been made to turn those ranges which cannot be crossed, and a direct series has actually been driven round these gigantic buttresses of the north on to the Pamirs. The results of this extraordinary feat are not yet published, but they furnish an example of what may be attempted in these days by the introduction of an improved class of comparatively small instruments.

[1] Abstract of an address delivered at the opening of the 160th session of the Royal Society of Arts on November 19, by the chairman of the council, Sir Thomas H. Holdich, K.C.M.G.

Reference was made in the address to the widespread increase of geographical knowledge during the last twenty-five years, and to the appreciation of geography as a leading subject for education in the universities and schools of England. This was not to be accepted as entirely due to an appreciation of the fact that the study of geography is an absolute necessity in face of the world-wide competition for commercial supremacy, or of political discussions involving the destiny of nations, or even in the field of the military campaign where geographical knowledge spells success. The effect of new facilities in the matter of locomotion counts for much in this stirring up of public interest in geography. People move rapidly, and they move widely and in ever-increasing numbers, and, to a great extent, they now study the map to know how and where they are going. The motor-car and the bicycle are responsible for much of this newly acquired interest in geography, and the mapping of the British Isles, and, in a less degree, of the Continent, is now familiar to thousands who would never have looked at a map fifty years ago. It is satisfactory to observe that the widespread knowledge thus distributed amongst the millions has become specialised with those whose business it is to conduct either political or military campaigns.

The very first element in the acquisition of geographical knowledge is the proper and correct use of technical geographical terms. In the course of the address instances were given of the disastrous results which may follow the use in political agreements of vague and loose geographical definitions or of the names of places the existence of which was not properly authenticated. The Russo-Afghan boundary settlement of 1884 was cited as an instance of the latter error. That boundary commission has become historical owing to the occurrence of the "regrettable incident" at Panjdeh, when a Russian force displaced the Afghans and secured an advance of the Russian frontier thereby which was never disputed by our Government, in spite of the fact that the joint commission was to effect a peaceable settlement of an international question. The Gladstone Government came to an end, and Lord Salisbury became Prime Minister just at the critical juncture when the success or failure of the mission hung in the balance. The Russian Commission took the field, and the settlement of the boundary proceeded. Then there ensued a useless and most expensive hunt, which lasted for months, in order to determine where on the Oxus a certain "post" existed, which was rendered an obligatory point in the boundary agreement, and which was nowhere to be found. Thousands of pounds were spent over that futile quest, which ended in the discovery that if such a "post" as that described in the protocol had ever existed at all it had disappeared long ago into the river-bed—so long ago as to be beyond the recollection of the oldest local authority. The prolongation of the Commission's stay in Afghanistan was not only expensive; it was dangerous, inasmuch as the temper of the Amir at that time was most uncertain. Moreover, the Russian Government was then to be as little trusted as that of Afghanistan. Useless delay was on every account to be avoided.

A wrong application of elementary geographical terms was instanced in the settlement of the eastern end of the same Russo-Afghan boundary in 1895. It was a matter of urgent importance that this boundary should be settled in the Pamir region in the short season which elapsed between the opening of the passes in the spring and the closing of them by snow in autumn. There was no reason to anticipate delay or difficulty arising from the determination of the geographical position set out in the political agreements. As in the case of the "Penjdeh" boundary, a scientific basis for that position had been carried from India to the scene of action, and the Russian men of science accepted the data of the English surveyors. Trouble came only when the boundary as defined in the agreement was to be carried in an easterly direction from a certain ascertained point to the Chinese frontier. This was the crucial point of the boundary inasmuch as it covered those passes which were supposed to lead from Russia Indiawards. It was the "easterly direction" which caused the trouble. Was it to be accepted as a little east of north, a little east of south, or due east? No agreement with the Russian representatives could be arrived at, and business came to an end. There was every prospect of a long and risky winter sojourn on the "roof of the world" for the Commission. Luckily the possible deadlock had been foreseen, and the political translation of the term "easterly direction" had been requested in advance. The answer came just in time to save the situation. The Commission was withdrawn (not without risk) over the passes, and the boundary region left to winter solitude. The expression "foot of the hills" proved to be a stumbling-block in the way of another important boundary settlement. What constitutes the "foot of the hills"? Is it where steep slopes end and the more gentle glacis, or fan, reaching down to the drainage line of the valley, commences, or is it that drainage line itself where all slopes end? The latter was once adopted as the free translation of that term, and so great was the indignation stirred up by that translation that it seemed likely to end in war.

Instances of want of appreciation of the slight elementary knowledge of geographical definitions such as would save similar mistakes might be multiplied, but, after all, the greatest losses in territory, or financially, have accrued from the actual want of properly authenticated map information when determining international boundaries. No instance perhaps exists of a more forcible character than that of the boundary dispute between the two great South American Republics, the Argentine and Chili. Here a boundary dispute resulted from the framing of an agreement between the political representatives of the two countries without any preliminary examination of the geographical features of the country concerned. The boundary, according to this agreement, was to follow the main range of the Cordillera of the Andes which parted the waters of the Pacific from those of the Atlantic. There are "main" ranges in the southern Andes of quite sufficient importance to justify the conditions required, if they did but part the waters of the Pacific from those of the Atlantic. But the great rivers that emptied themselves into the Pacific had their sources in the flat plains of Argentine Patagonia, and traversed the Andes from side to side. The dispute involved quite a library of learned treatises on the subject, and cost the two countries quite 120 millions in preparation for war before it was referred to British arbitration.

It is therefore of universal national importance that means should be provided for the determination of certain absolutely fixed positions in their coordinate values of latitude and longitude if international boundaries are to be preserved. Great and impassable ranges and rivers (if the rivers flow through permanent and rocky channels), broad deserts, and certain other natural features, such as well-marked water partings, may stand well enough for the dividing wall between contiguous countries, where they exist; but over flat and cultivated plains the only lasting artificial boundary mark must be one the position of which is so determined that there can be no room for dispute about it, even if it should be removed or perish through age. This is only to be effected by accurate survey work based ultimately on geodetic triangulation, and it is this work carried out by British officers in so many parts of the world, with the aid of modern light and efficient instruments, which is gradually working out the boundaries of nations, and, incidentally, carrying geographical mapping into the remotest regions of the world. The invention of a portable receiver for the transmission of signals by wireless telegraphy is likely to be of the greatest importance to these workers in remote geographical fields. Here again the perfecting of a minor form of installation for wireless telegraphy is rapidly leading to developments of which we are at present only dimly conscious.

What the Society of Arts can do in this special field of activity, after teaching people to believe in science, is to foster by all means in its power such aids to the progress of knowledge as are to be found in new inventions, new developments, and adaptations of instrumental means for observation and measurement in the endless process of collecting information.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Sir Arthur Evans has presented to the museum the last instalment of an interesting set of objects selected from the collections of his father, the late Sir John Evans. The gift consists of 121 specimens ranging in date from prehistoric times to the eighteenth century. The value of the collection is greatly enhanced by the fact that all the specimens composing it were found in Cambridgeshire and the adjacent counties.

Mr. C. S. Wright has been appointed University lecturer in surveying and cartography (Royal Geographical Society lecturer).

Dr. Assheton has been appointed University lecturer in animal embryology.

The new Gresham College in Basinghall Street, London, E.C., was formally opened by the Lord Mayor on December 15. Mr. Sheriff Painter, chairman of the City side of the Gresham Committee, gave a history of the Gresham Trust, which, he said, came into operation in 1596 after the death of the founder, Sir Thomas Gresham, and his widow. Under Gresham's will seven lectureships were founded in divinity, astronomy, music, geometry, civil law, physic, and rhetoric. For the first 200 years those lectures were delivered at the mansion of Sir Thomas Gresham, in the parish of St. Helen's, Bishopsgate, where Gresham House stood. The first Gresham College was opened in 1843, and the lectures were delivered there until a few years ago, when as it became inadequate to present-day uses, it was demolished and the new building was erected. The building, which is larger than the old college, has a frontage to Gresham Street of about 71 ft. and to Basinghall Street of 58 ft. The lecture hall and gallery will seat about 430 persons. The hall is lined throughout with oak. Provision is made for a complete kinematograph apparatus for use in the scientific and medical lectures. The building has cost about 34,000*l*.

Speaking at the National Liberal Club on the subject of Liberalism and education, Lord Haldane said that when this nation came into existence as a great industrial nation it had practically no competitors. At that time dash and "go" and practical skill alone were required. Now the art of manufacture is linked with the science of education. It is a business which is controlled by scientific principles, and woe will befall the country which is lacking in the scientific equipment necessary to enable it to compete with its more favoured rivals. In Germany and America great progress is being made in the realisation of the truth that, not only must young men and women be prepared from an early age if they are to be made experts in their vocations in life, but that in their vocational training a large amount of general education must be given. The question will have to be faced in this country, and the only point is whether the public will give to the educational movement that support without which no Chancellor of the Exchequer can make headway. An effort in the direction of higher education is necessary if this nation is to hold its own. Upon the same occasion Mr. J. A. Pease said that the view that education should be made compulsory up to the age of sixteen is an ideal which it is impossible to attain; but he hopes that the present limit may be raised to fourteen years.

Arrangements have been made for a large number of educational conferences in London early in the new year. Twenty-one educational associations are co-operating in a conference to be held in the University of London on January 2–10, which will be opened by an address by Mr. James Bryce on "Salient Educational Issues." Among the associations taking part may be mentioned the Geographical Association, of which Dr. J. Scott Keltie is the president, whose address will be, "Thirty Years' Progress in Geographical Education"; the School Nature Study Society; the Association of Science Teachers; the Child Study Society; and the Associations of Teachers in Domestic Subjects and in Technical Institutions. The London County Council has arranged another conference of teachers, to be held at Birkbeck College from January 1 to 3. One of the six meetings is to be devoted to a consideration of the subject of mental fatigue, another to memory drawing, and two others to educational experiments in schools. The Mathematical Association will hold its annual meeting at the London Day Training College on January 7. Among the papers to be read in the morning we notice one by Prof. J. E. A. Steggall on practical mathematics in school. In the afternoon the president of the association, Sir George Greenhill, will give an address on the use of mathematics, and Dr. W. N. Shaw will speak on "Principia Atmospherica."

The governors of the Imperial College of Science and Technology, at their meeting on Friday last, constituted two new chairs of chemistry, and appointed two new professors—Dr. Jocelyn Field Thorpe, F.R.S., professor of organic chemistry, and Dr. James C. Philip, professor of physical chemistry. Four years ago Dr. Thorpe was elected to the Sorby research fellowship of the Royal Society, which he has held at the University of Sheffield. He was formerly research fellow and lecturer in chemistry at the University of Manchester, and received his earlier training partly in London, at the Royal College of Science, and partly in Germany, where, at Heidelberg, he studied under Victor Meyer and Prof. Auwers. Dr. Philip has been on the staff of the Imperial College for some years latterly as an assistant professor. He is well known for his work on physical chemistry, and is now one of the secretaries of the Chemical Society. He is a graduate of Aberdeen and Göttingen Universities. The department of chemistry in the Imperial College has now four professors—Prof. H. Brereton Baker, F.R.S., who is professor of chemistry and director of the laboratories; Prof. W. A. Bone, F.R.S., professor of chemical technology (fuel and refractory materials), together with the two new professors. At present there are 117 students working specially at chemistry, including its technological applications, of which number thirty-six are engaged in research. In addition, the department provides the subsidiary training in chemistry for about 329 other students.

THE annual prize distribution of the Sir John Cass Technical Institute was held on Wednesday, December 10, when the prizes were distributed by Sir Thomas H. Elliott, K.C.B., Deputy Master and Comptroller of the Royal Mint. The chair was taken by Sir Owen Roberts, chairman of the governing body of the institute. Sir Thomas Elliott, in addressing the students, spoke of the desirability of keeping in view the aim of the instruction provided at the institute, the object of its work, and the extent to which this object was being accomplished. He was himself disposed to say that the primary purpose for which the institute exists is to assist students to do justice to themselves and to those who may be or become dependent upon them, to enable them to perform services which the community requires and for which the community is prepared to pay, and to pay well, to increase their earning powers, and so to help them to secure a better livelihood for themselves than would otherwise be theirs. He counselled the students not to be afraid of selecting a manual occupation and in connection with it to endeavour to learn all the facts connected with the material used, the machinery employed, and the scientific principles upon which the work is based. The Rev. J. F. Marr, chairman of the institute committee, gave a summary account of the work of the institute during the past session, in which he referred especially to the increasing number of students, the research work that had been carried on in the institute, both by students and by members of the staff, and the several developments in the courses of instruction provided. In the latter connection details were given of the work on colloids, on the theory and applications of mathematical statistics, on the fermentation industries, on mine sampling and valuing, on metals used in the motor-car industry, and on the casting of metals, all subjects which had received the special attention of the governing body during the past session.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 28.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—Prof. H. L. **Callendar**: The expansion of silica. In attempting to deduce the expansion of mercury by the weight thermometer method with silica bulbs it was necessary to determine the expansion of specimens of silica from the same source as the bulbs, and to extend the observations of expansion over the range 0° C. to 300° C. Specimens which had been exposed to high temperatures appeared to give lower results over the range 0° C. to 300° C. than specimens which had not been heated above 300° C. during the measurements. Specimens of the same material, (1) in the form of rods were obtained and were heated and tested by the Newton ring method over the range 0° C. to 300° C.; and (2) in the form of tubes, which were tested by the Fizeau method over the range −20° C. to 150° C. The difference between the axial and radial coefficients of the tube specimens had also been tested. The expansion of the silica rod gave results agreeing with the extrapolation of the curve representing the original observations between 300° C. and 1000° C. The silica rods showed at first some peculiarities due to intrinsic strain, but settled down into a cyclic state which could be represented over the range 0° C. to 300° C. by the formula $10^8 \times$ mean coefficient 0° to $t = 78{\cdot}0 - 8650/(t+175)$, but the variation of the coefficient with temperature was rapid and peculiar over this range and could not be represented by a formula of the usual type. The axial expansion of four different specimens had been measured, and could be represented between −20° C. and 150° C., with a little divergence by the formula, $10^8 \times$ mean coefficient 0° to $t = 29{\cdot}0 + 0{\cdot}250t - 0{\cdot}00070t^2$, which agreed over this range with the formula found for the rods, but was inadmissible for extrapolation to 300° C. The difference between the radial and axial coefficients was tested. Differences of the order of 5 or 10 per cent. in the expansion in different directions appeared to be persistent, and were not removed by heating the specimens to 1000° C. or cooling in liquid air. It was concluded that the differences in the radial coefficient might be due to distortion of the ring. It was considered that the most probable result for the cubical coefficient would be obtained by assuming it to be three times the linear. Owing to the smallness of the expansion of silica, and its comparative freedom from hysteresis, the possible uncertainty with the silica bulbs was probably less than 1 in 1000, in spite of the imperfect annealing.—F. J. **Harlow**: The thermal expansions of mercury and fused silica. A more complete set of observations of the relative coefficients of expansion of mercury in silica than those previously published are obtained by the use of an electrically heated oil bath. The observations comprise readings at frequent intervals up to 300° C., and are in good agreement with the earlier observations. Tables are included giving representative observations and the final results. From the values of the coefficients of expansion of silica determined by Prof. Callendar, the coefficients of absolute expansion of mercury are calculated.—Prof J. A. **Fleming**: An experimental method for the production of vibrations on strings. An apparatus for the production of vibrations of strings loaded or unloaded was shown. The vibrations are produced on a string by attaching one end to the shaft of a small continuous-current motor of about $\frac{1}{8}$ h.p. The other end of the string is attached to a fixed point which can be moved by means of a screw, in some cases a spring balance being interposed to measure the tension. When the motor is started the string has a circular motion given to its end which is equivalent to two simple harmonic motions at right angles to each other. If the tension is adjusted rightly the string then vibrates in sections, and the number of sections can be adjusted. The distance from node to node can then be measured easily, and the frequency determined from the speed of the motor. In this way the velocity of the wave is measured, and can be compared with the velocity determined by taking the square root of the quotient of the tension by the linear density of the string. This method is useful in studying the properties of loaded strings. When the wave-length on the string extends over a distance of more than eight or ten loads, the string vibrates as if the loading matter were distributed uniformly, but the string cannot propagate vibrations when the half wave-length approaches equality to the distance between two loads. It is possible to show the reflection of a wave at a load placed at any point on the string, and also that this reflection is reduced by tapering off the loading. With this loaded vibrating string all the phenomena of inductive loading in telephone cables on the Pupin system can be imitated.

Geological Society, December 3.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. E. A. Newell **Arber**: A contribution to our knowledge of the geology of the Kent Coalfield. An account of the

Carboniferous rocks of Kent is given. The Mesozoic cover of the coalfield is ignored. The proved area is 200 square miles. The general strike is about 30° south of east and north of west, and the dip of the Transition Coal Measures is 2° to 3°. The area is a syncline, limited on the north and south by Armorican folds, of which the northern has been located. It is maintained that the Kent Coalfield is not continuous with that of the Pas de Calais. There are reasons for believing that the western boundary is a great fault. The chief surface-feature of the Coal Measures is that of an inclined plane, sloping westwards and south-westwards from an elevated region near Ripple and Deal. The Lower Carboniferous rocks exceed 450 ft. in thickness, and were denuded before the Coal Measures were deposited. The Coal Measures consist of the Transition Series (1700 to 2000 ft. thick), and the Middle Coal Measures (2000 ft.). No Lower Coal Measures or Millstone Grit occur. The coals are well distributed, and are often of considerable thickness. Steam and household coals predominate. The most productive portions of the measures are the higher part of the Transition and the lower part of the Middle Coal Measures.—Dr. E. A. Newell **Arber**: The fossil floras of the Kent Coalfield. The floras of ten further borings in Kent are recorded, and the number of species known from the Kent Coalfield is raised to ninety-six, as compared with twenty-six in 1909. As regards the horizons present in Kent, the plant-remains indicate that, in the area so far proved, only Middle or Transition Coal Measures, or both, occur.

Linnean Society, December 4.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Jane **Longstaff**: A collection of non-marine Mollusca from the southern Sudan. With descriptions of three new species by H. B. **Preston**; and notes on *Veronicella nilotica*, Cockerell, by G. C. **Robson**. This records the Mollusca taken during two visits to the Sudan in February, 1909 and 1912. About fifty-three species were taken, thirty-four Gasteropoda and nineteen Lamellibranchiata, the aquatic, of course, having a wider range than the terrestrial forms. The only terrestrial gasteropod found alive was a *Veronicella nilotica*, Cockerell, the second recorded example.—A. S. **Horne**: A contribution to the study of the evolution of the flower, with special reference to the Hamamelidaceæ, Caprifoliaceæ, and Cornaceæ.

Mathematical Society, December 11.—Prof. A. E. H. Love, F.R.S., president, in the chair.—Prof. E. W. **Hobson**: The linear integral equation.—H. E. J. **Curzon**: Generalised Hermite functions and their connection with the Bessel functions.—J. **Proudman**: Limiting forms of long-period tides.—Lieut.-Col. **Cunningham**: The number of primes of the same residuacity.—R. H. **Fowler**: Some results on the form near infinity of real continuous solutions of a certain type of second order differential equation.—S. **Brodetsky**: The potential of a uniform convex solid possessing a plane of symmetry with application to the direct integration of the potential of a uniform ellipsoid. G. R. **Goldbrough**: The dynamical theory of the tides in a polar basin.—Prof. J. C. **Fields**: Proof of the complementary theorem.

CAMBRIDGE.

Philosophical Society, November 24.—Prof. Newall in the chair. Prof. A. S. **Eddington**: The distribution of the stars in relation to spectral type. It is well known that the concentration of stars to the galactic plane is not shown equally by the different spectral classes. Type B is the most condensed, and the others follow in the order A, F, G, K, M, *i.e.* the sequence coincides with the usually accepted order of evolution. Formerly it seemed probable that this result was due to a progression in the average distance of these classes of stars, for, on the hypothesis that the stellar system is of oblate form, the greater the distance the greater will be the concentration to be expected. Recent determinations by Boss and Campbell of the average distances of the stars of different spectral types negative this explanation in a most decided manner. It appears, for instance, that the M stars are on the average more remote and more luminous than type A. There is an outstanding question of great difficulty. In parallax investigations it is found that the M stars are the faintest of all the types; in statistical discussions of proper motions, &c., they are found to be the brightest except type B. Similar difficulties occur with the other types. Russell has put forward the theory that type M consists of two divisions, one being the very earliest and the other the latest stage in evolution. Against this it may be urged that both divisions of type M are characterised by very high velocities in space; this seems to indicate a close relation between them.—Dr. G. F. C. **Searle**: (1) The comparison of nearly equal electrical resistances. Four resistance coils, A, B, C, D, are arranged to form the four sides of a Wheatstone's quadrilateral. The coils C, D are approximately equal, but, as their ratio is eliminated, it is not necessary to know it. A balance is obtained by shunting A, B with large resistances a_1, b_1. The coils A and B are then interchanged and a fresh balance is obtained by shunting them with a_2 and b_2. (2) An experiment on the harmonic motion of a rigid body.—G. T. **Bennett**: A double-four mechanism.—F. E. **Baxandall**: The presence of certain lines of magnesium in stellar spectra. In a recent paper on new series of lines in the spark spectrum of magnesium, Prof. Fowler gives spark lines of magnesium at wave-lengths 4384·86, 4390·80, 4428·20, 4434·20, which do not fall into series. Weak lines in apparently corresponding positions have been found in the spectra of α Canis Majoris (type A_0) and α Cygni (type A_2, Pec.), and the suggestion is made that the stellar and laboratory lines are identical. It is in such stellar spectra as those mentioned that the well-known Mg spark line at wave-length 4481·3 occurs at its maximum intensity. The new lines have not been traced in any other types of stellar spectra.

MANCHESTER.

Literary and Philosophical Society, November 18.—Mr. Francis Nicholson, president, in the chair. Prof. G. Elliot **Smith**: The controversies concerning the interpretation and meaning of the remains of the dawn-man found near Piltdown. The author explained the nature of the controversies concerning other bearings of the Piltdown discovery on the history of ancient man: (1) the age of the remains; (2) the question of the association of the jaw and the skull; (3) the significance of the jaw and teeth and the reconstruction of the missing parts; (4) the reconstruction of the brain-cast and the nature of the brain; and (5) the place which Eoanthropus should occupy in the phylogeny of the Hominidæ. (1) It is practically certain that the fragments are of the Pleistocene date. (2) There is definite internal evidence that the jaw is not really an ape's; the teeth it bears are human, and the skull, although human, is much more primitive than any skull assigned to the genus Homo. (3) The reconstruction of the jaw and teeth has now been practically settled once for all by the subsequent discovery of the canine tooth. (4) He considered that there was no longer room for doubt as to the position the fragments originally occupied in the skull; and it is very improbable that the complete brain-cast could be more than 1100 c.c. in capacity. (5) There seems ample justification for putting the Piltdown remains into a genus separate from all the other Hominidæ. Eoanthropus must represent a persistent and very slightly modified descendant of the common ancestor of *Homo sapiens* and *H. primigenius*. There is no positive evidence that the genus Homo, or even Eoanthropus, had come into existence in Pliocene times. The fact of *E. dawsoni* being found in a deposit that may perhaps be as late as the Mid-Pleistocene does not invalidate the conclusion that the genus to which it belonged was ancestral to the Heidelberg man. When man was first evolved the pace of evolution must have been remarkably rapid, and it is quite possible that amidst the turmoil incidental to the inauguration of the Pleistocene period a new group of anthropoids rose superior to the new difficulties, and became "dawn-men." It is almost certain that man began to speak when his jaw was in the stage represented in that of Eoanthropus. The brain already shows considerable development of the parts associated in modern man with the power of speech.

NEW SOUTH WALES.

Linnean Society, October 29.—Mr. W. S. Dun, president, in the chair.—Dr. J. M. **Petrie**: Hydrocyanic acid in plants. Part ii., Its distribution in the grasses of New South Wales. The existence of hydrocyanic acid in the Gramineæ was discovered by Jorissen, in 1884. Since then, about thirty species have been recorded as containing a cyanogenetic compound. The author's work is a continuation of investigations into the cause of sudden fatalities among sheep in this State. More than 200 species of grasses were tested systematically. Glucosides, capable of yielding hydrocyanic acid, were detected in twenty species, eleven of these being native grasses, the others introduced. The acid existed free in only two species, *Cynodon incompletus* and *Diplachne dubia*; in the rest, it is mainly combined as glucoside, and, therefore, only liberated by contact with the natural ferment of the plant under favourable conditions.—Archdeacon F. E. **Haviland**: Notes on the indigenous plants of the Cobar district, N.S.W. No. 2. In this second contribution the number of natural orders represented in the Cobar district is increased from 64 to 71; of genera, from 197 to 275; and of species, from 337–504.—E. **Turner**: New fossorial Hymenoptera from Australia and Tasmania.

BOOKS RECEIVED.

Exercises from A New Algebra. Parts i.–iv. By S. Barnard and J. M. Child. Pp. 274. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*.

Hunting the Elephant in Africa, and other Recollections of Thirteen Years' Wanderings. By Capt. C. H. Stigand. Pp. xv+379. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

Examples in Physics. By H. Freeman and E. Jobling. Pp. 96. (Cambridge: W. Heffer and Sons, Ltd.) 1*s*. net.

La Technique de la Radiotélégraphie. By Dr. H. Rein. Translated by G. Viard. Pp. x+262+v plates. (Paris: Gauthier-Villars.) 9 francs.

Leçons de Mathématiques Générales. By Prof. L. Zoretti. Pp. xvi+753. (Paris: Gauthier-Villars.) 20 francs.

Paléontologie végétale. By Dr. F. Pelourde. Pp. xxviii+360. (Paris: O. Doin et Fils.) 5 francs.

Die Brownsche Bewegung und einige verwandte Erscheinungen. By Dr G. L. de Haas-Lorentz. Pp. 103. (Braunschweig: F. Vieweg und Sohn.) 3.50 marks.

Der heutige Stand der Synthese von Pflanzenalkaloiden. By Dr. H. Bauer. Pp. viii+144. (Braunschweig: F. Vieweg und Sohn.) 4.50 marks.

Tensoren und Dyaden im dreidimensionalen Raum. By E. Budde. Pp. xii+248. (Braunschweig: F. Vieweg und Sohn.) 6 marks.

Industrial Mathematics. By H. W. Marsh, with the collaboration of A. G. F. Marsh. Pp. viii+477. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

Smithsonian Institution. U.S. National Museum. Bulletin 80. A Descriptive Account of the Building Recently Erected for the Department of Natural History of the U.S. National Museum. By R. Rathbun. Pp. 131+34 plates. (Washington: Government Printing Office.)

History of Geography. By Dr. J. Scott Keltie and O. J. R. Howarth. Pp. ix+154. (London: Watts and Co.) 1*s*. net.

Guide to the Materials for U.S. History in Canadian Archives. By D. W. Parker. Pp. x+339. (Washington: Carnegie Institution.)

The Sabanu. The Studies of a Sub-Visayan Mountain Folk of Mindanao. Part i., by Lieut.-Col. J. P. Finley. Part ii., by W. Churchill. Pp. v+236+2 plates. (Washington: Carnegie Instiution.)

Heredity in Skin Color in Negro-White Crosses. By C. B. Davenport. Pp. 106+4 plates. (Washington: Carnegie Institution.)

Guide to Materials for the History of the U.S. in the Principal Archives of Mexico. By Prof. H. E. Bolton. Pp. xv+553. (Washington: Carnegie Institution.)

Metallographie. Erster Band. Die Konstitution. Zweiter Teil. Heft. 1. Die Konstitution des Systemes Eisen-Kohlenstoff sowie der sonstigen binären Kohlenstofflegierungen. By Dr. W. Guertler. Pp. xl+648+plates. (Berlin: Gebrüder Borntraeger.) 32 marks.

Handworterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief 64–68. (Jena: G. Fischer.) 2.50 marks each Lief.

The Englishwoman's Year Book and Directory, 1914. Edited by G. E. Mitton. Pp. xxxii+431. (London: A. and C. Black.) 2*s*. 6*d*. net.

Who's Who, 1914. Pp. xxx+2314. (London: A. and C. Black.) 15*s*. net.

Who's Who Year-Book for 1914–15. Pp. vii+178. (London: A. and C. Black.) 1*s*. net.

The Writers' and Artists' Year-Book. Edited by G. E. Mitton. Pp. x+154. (London: A. and C. Black.) 1*s*. net.

The American Annual of Photography, 1914. Edited by P. Y. Howe. Pp. 328. (New York: American Annual of Photography Inc.; London: G. Routledge and Sons, Ltd.) 3*s*. 6*d*. net.

Union of South Africa. Mines Department. Annual Reports for 1912. Part iv., Geological Survey. Pp. 193+xvii plates. (Pretoria: Government Printing and Stationery Office.) 7*s*. 6*d*.

Who's Who in Science. International, 1914. Edited by H. H. Stephenson. Pp. xx+662. (London: J. and A. Churchill.) 10*s*. net.

Transactions of the Royal Society of Edinburgh. Vol. xlix. Part 2. Session 1912–13. Pp. 229–529+plates. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 32*s*. 6*d*.

Continuity. By Sir Oliver Lodge. Pp. 118. (London: J. M. Dent and Sons, Ltd.) 1*s*. net.

Elementary Practical Electricity and Magnetism. By J. C. Kirkman. Pp 136. (London: G. G. Harrap and Co.) 2*s*. 6*d*. net.

Coconut Cultivation and Plantation Machinery. By H. L. Coghlan and J. W. Hinchley. Pp. xii+128+x plates. (London: Crosby Lockwood and Son.) 3*s*. 6*d*.

L'Education de l'Effort Psychologie-Physiologie. By Prof. G. Demenij. Pp. vii+228. (Paris: F. Alcan.) 3.50 francs.

Junior Geometry. By A. G. Cracknell. Pp. viii+276. (London: W. B. Clive.) 2*s*. 6*d*.

Garden Farming. By L. C. Corbett Pp. x+473. (Boston, Mass., and London: Ginn and Co.) 8*s*. 6*d*.

Our Domestic Birds: Elementary Lessons in Aviculture. By J. H. Robinson. Pp x+317. (Boston, Mass., and London: Ginn and Co.) 6*s*.

Physical Chemistry: its Bearing on Biology and Medicine. By Prof. J. C. Philip. Second edition. Pp. vii+326. (London: E. Arnold.) 7*s*. 6*d*. net.

Echoes: A Book of Verse. By A. L. H. Anderson. Pp. 80. (London: Elkin Mathews.) 2*s*. 6*d*. net.

A New Era in Chemistry. By H. C. Jones. Pp. xii+326. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Catalogue of Hardy Trees and Shrubs Growing at Albury Park, Surrey. Compiled by A. B. Jackson. Pp. x+66. (London: West, Newman and Co.)

Durch König Tschulalongkorns Reich. Eine deutsche Siam-Expedition. By Dr. C. C. Hosseus. Pp. xii+219+plates. (Stuttgart: Strecker and Schröder.) 15 marks.

Report on the Crustacea Schizopoda Collected by the Swedish Antarctic Expedition 1901–3, under the Charge of Baron Dr. O. Nordenskjöld. By H. J. Hansen. Pp. 56+vi plates. (Copenhagen: G. E. C. Gad.)

The Golden Bough. Third edition. Part vii. Balder the Beautiful. By Prof. J. G. Frazer. 2 vols. Pp. xx+346; xi+389. (London: Macmillan and Co., Ltd.) 20*s*. net.

Theodore Roosevelt: an Autobiography. Pp. xii+647. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

My Life with the Eskimo. By V. Stefánsson. Pp. ix+538. (London: Macmillan and Co., Ltd.) 17*s*. net.

A History of Land Mammals in the Western Hemisphere. By Prof. W. B. Scott. Pp. xiv+693. (London: Macmillan and Co., Ltd.) 21*s*. net.

A School Statics. By G. W. Brewster and C. J. L. Wagstaff. Pp. viii+248. (Cambridge: W. Heffer and Sons, Ltd.) 3*s*. net.

A Proper Newe Booke of Cokerye. Edited by C. F. Frere. Pp. clxiv+124. (Cambridge: W. Heffer and Sons, Ltd.) 7*s*. 6*d*. net.

Robert Bridges, Poet Laureate. Readings from his Poems. By Prof. T. H. Warren. Pp. 39. (Oxford: Clarendon Press.) 1*s* net.

Hazell's Annual for 1914. Edited by Dr. T. A. Ingram. Pp. cxi+592. (London: Hazell, Watson and Viney, Ltd.) 3*s*. 6*d*. net.

Geological Survey of New Jersey. Bulletin No. 10. The Mechanical and Chemical Composition of the Soils of the Sussex Area, New Jersey. By A. W. Blair and H. Jenning. Pp. 110+2 plates. Bulletin No. 11. The Mineral Industry of New Jersey for 1912. By Dr. M. W. Twitchell. Pp. 43. (Trenton, New Jersey.)

Catalogue of the Mesozoic Plants in the British Museum (Natural History). The Cretaceous Flora. Part i. Bibliography, Algæ, and Fungi. By Dr. M. C. Stopes. Pp. xxiii+285. (London: British Museum (Natural History); Longmans and Co.) 12*s*.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 18.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Employment of Power in H.M. Post Office: H. C. Gunton.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Standardising of Colours and Symbols representing Geographical Data, especially on Small Scale Maps: Prof. A. J. Herbertson.

LINNEAN SOCIETY, at 8.—The Evolution of the Inflorescence: J. Parkin.—*Hypericum desetangsii*, Lamotte, a New British Plant: C. E. Salmon.—The Mouth-parts and Mechanism of Sucking in *Schizoneura lanigera*: J. Davidson.

INSTITUTION OF MINING AND METALLURGY, at 8.—Cupellation Experiments. II.: A Simple Method for the Detection of the Platinum Metals in Cupellation Beads: C. O. Bannister and G. Patchin.—Notes on Mines in the Ottoman Empire: G. Maitland Edwards.

FRIDAY, DECEMBER 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Mechanical Engineering Aspects of Road Construction: Col. R. E. B. Crompton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Air-filtration and the Cooling and Ventilation of Electrical Machines: W. E. Gurry.

MONDAY, DECEMBER 22.

ARISTOTELIAN SOCIETY, at 8.—William of Ockham on Universals: C. Delisle Burns.

INSTITUTE OF ACTUARIES, at 5.—Whole Life Non-profit Assurances: F. J. Cameron.

TUESDAY, DECEMBER 23.

INSTITUTION OF CIVIL ENGINEERS at 8.—*Further Discussion*: Cyclical Changes of Temperature in a Gas-engine Cylinder: Prof. E. G. Coker and W. A. Scoble

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THURSDAY, DECEMBER 25, 1913.

THE PEOPLING OF MELANESIA.

Wissenschaftliche Ergebnisse einer amtlichen Forschungsreise nach dem Bismarck-Archipel im Jahre 1908. III. Untersuchungen über eine melanesische Wanderstrasse. Von Dr. Georg Friederici. [Mitteilungen aus dem Deutschen Schutzgebieten. Ergänzungsheft Nr. 7.] Pp. iii+182. (Berlin: E. S. Mittler und Sohn, 1913.) Price 3.60 marks.

IN this volume Dr. Friederici has used the results of his personal inquiries into the linguistics and ethnology of the Bismarck Archipelago in an endeavour to trace the path of the Melanesian people from Indonesia to their present settlements east and south of New Guinea.

In the second volume of the "Results" of the Hanseatic South Sea Expedition of 1908 Dr. Friederici gave a compendious account of the ethnography and languages of the archipelago, with special studies of certain implements and navigation. From these he concluded that there was evidence of a considerable connection between the people of the Bismarck Archipelago and those of the region roughly indicated by a line drawn from the Southern Philippines across north-east Celebes, to the Moluccas in the neighbourhood of Ceram and Buru. The present volume deals with the evidence in more detail. A comparison of the languages of the Barriai and related peoples of North New Pommern shows many agreements in grammar and vocabulary with the group of languages known as the Bahasa Tanah of the Alfurus (or inlanders) of Ceram and the adjacent Moluccan islands, and Dr. Friederici concludes that the Melanesians originally came from that region, though they were considerably modified by another stream of immigrants from the region included between the Southern Philippines, North Borneo, and the Minahasa peninsula of Celebes. On reaching the Bismarck Archipelago a portion of the Moluccan swarm passed through Vitiaz Strait and settled along the coast of south and south-eastern New Guinea. Another portion, after colonising the shores of New Pommern and New Mecklenburg, passed through Dampier Strait to the northern islands of the Louisiades, the Southern Solomons, and the New Hebrides. The immigrants from the sub-Philippine region took a more northerly route by the Admiralty group to New Hanover, East New Mecklenburg, and the Solomon Islands.

Although his argument is based mainly on the languages, Dr. Friederici recognises the difficulties in definitely fixing the position of the Melanesians, which arise from their great variation in physical appearance and culture. But he maintains that a close agreement in the fundamental structure of the languages and the presence in them of important and numerous common words is evidence of the presence of the carriers of the languages in the places where they are now found. He points out also a number of ethnological facts which support the conclusions based on linguistics.

Dr. Friederici's book will be found of much value to the student of oceanic ethnology. It increases very considerably our knowledge of the languages of the Bismarck Archipelago. It affords a satisfactory indication of at least one path by which the speakers of Melanesian languages entered the Pacific, though it leaves still unsolved the problems of the northern and eastern Pacific, and the details of the dispersal of the Melanesian swarm after its passage through the Vitiaz and Dampier channels.

The work would have been improved by an index, and in the absence of a purely linguistic map of the archipelago there is some difficulty in locating the languages. The names do not always agree with those appearing on maps in former volumes of the "Results."

SIDNEY H. RAY.

REGIONAL AND GENERAL GEOGRAPHY.

(1) *Tirol, Vorarlberg und Liechtenstein.* By Prof. K. W. von Dalla Torre. Pp. xxiv+486. (Berlin: W. Junk, 1913.) Price 6 marks.

(2) *Mittelmeerbilder.* Gesammelte Abhandlungen zur Kunde der Mittelmeerländer. By Dr. Theobald Fischer. Zweite Auflage, besorgt von Dr. A. Rühl. Pp. vi+472. (Leipzig and Berlin: B. G. Teubner, 1913.) Price 7 marks.

(3) *La Région du Haut Tell en Tunisie.* (Le Kef, Téboursouk, Mactar, Thala) Essai de Monographie Géographique. By Dr. Ch. Monchicourt. Pp. xiv+487+plates. (Paris: Librairie Armand Colin, 1913.) Price 12 francs.

(4) *Animal Geography: The Faunas of the Natural Regions of the Globe.* By Dr. M. I. Newbigin. Pp. 238. (Oxford: Clarendon Press, 1913.) Price 4s. 6d.

(5) *A Commercial Geography of the World.* By O. J. R. Howarth. Pp. 236. (Oxford: Clarendon Press, 1913.) Price 2s. 6d.

(1) PROF. VON DALLA TORRE'S contribution to Junk's "Natur-Führer" is produced in the well-known style of "Baedeker's Guides," and is a scientific companion for the pedestrian or the cyclist. The commonplace details as to hotels and meals, railway-tickets, and gratuities to custodians, are omitted altogether; in their place we find a truly marvellous amount of information on natural phenomena, from scenic details to botanical species, arranged topographically, just as we come across them on the

S

routes. Human antiquities, from Roman times back to the cave-dwellers, are also noticed. It is impossible to give a fair idea of the personal observation and literary research that have resulted in these crowded pages. Two examples may be suggestive; but we must select from small places to keep the quotations within bounds. Here (p. 218) is Sillian, one of the delightful villages in the valley of the Drau:—

"1101 m. at the mouth of the *Villgratental*: quartz-phyllite and mica-schist. *Minerals:* Mispickel on the Davinealp. *Folklore:* Hard-hearted peasants: black biting dragons ate up everything, until in the end they were exorcised; still called "Bannhof" to this day. Gunshots from a ghost, who had sworn falsely. *Earthquakes:* 1827, 2, IV., 1 o'clock" (followed by a list of seven others).

Our second example has also some human interest (p. 191):—

"*St. Valentin auf der Haid,* 1470 m., surrounded by dense woods; founded 1140 as a hospice. *Geology:* huge detrital cone of verrucano and gneissic phyllite from the Endkopf. *Fauna:* Osprey, 1896. *Anthropology:* 21·1 per cent. brachy-, 78·9 per cent. hyperbrachy-cephals."

The following "modern instance" does not seem strictly natural; but its anthropological bearing may excuse it (p. 161):—

"In the Post Hotel stands the famous Schrofenstein vat; more than 400 years old, which held the wine, 400 years old, that once became renowned. The contents disappeared during the Bavarian occupation."

No intelligent visitor to Tyrol will grudge the moderate price of this new encyclopædic pocket-book.

(2) Dr. Rühl's edition of Fischer's "Mittelmeer-bilder" renders this series of essays available for every traveller. We can imagine no more interesting companion during a sea-voyage in the Mediterranean. The original dates are assigned to the descriptions in all cases. In 1886, Fischer was somewhat doubtful about the power of the French to pacify Tunisia; but surely the indifference of the Mohammedans to the advantages of foreign rule lies in the simplicity of their aspirations in this world, and not in any special antipathy inspired by the French. The military domination to which Fischer refers is at the present time very gracefully concealed, and he gives every credit to the protectors in a later essay (p. 404). His ride through Feriana to the great oasis of Gafsa on the desert edge, undertaken in a critical year, must have helped to direct attention to a country of extraordinary interest. The return of Latin influences to North Africa is one of the most fascinating themes for a geographer, and Hilaire Belloc, in his "Esto perpetua," has gone shortly to the heart of it. Fischer, of course, gives us much more, and in so lucid and balanced a style that we read with equal pleasure of the olive trade and the folding of the Atlas. Curiously enough, it is Belloc that produces the most vivid impression of the structure of the country.

Fischer also penetrated Morocco; he supplies good general surveys of Palestine, Italy, Corsica, and of Spain, with its contrasts between life on the marginal lands and the interior; and he everywhere lays stress on human interests, to which his studies in natural history are subordinate.

(3) M. Monchicourt's monograph on a special district of Tunisia is an example of the thoroughness brought by French scientific men into the study of the protectorate. The Haut Tell is the region south-west of Tunis, which stretches from Testour to the Algerian frontier, including Teboursouk and El Kef as its important towns. The word *tell* is used in Tunisia, not for a geographical feature, but for a black or yellow clay-land, which maintains a reserve of water for cereals, even in dry seasons. The author's Tell country is that in which *tell* is the common soil (p. 13), and it can be fairly limited as a northern region, while the Steppe, and finally the Sahara, succeed it as we travel south. The open and mostly lowland country that one finds so freely described as Sahel is attached partly to the Tell and partly to the Steppe.

The railway from Algeria enters the Haut Tell along the grand valley of the Medjerda, emerging on a rich alluvial plain. The beauty of the Roman remains at Dougga also attracts visitors from Tunis. But the southern area is far less known, though one sees brown mule-roads leading into it across the hills from Kairouan. The author indicates (p. 122) how it may be developed by using an old trade route. His photographic illustrations are excellent, and one feels that the surface-features which he so well describes are fundamentally connected with the structure and climate of the district. The ethnographic considerations bring us to the most important problem of ethnology, the maintenance of the population in harmony with the natural conditions of their fatherland.

(4) Dr. M. Newbigin has produced another book that can be read from cover to cover with grateful appreciation. The field is a very wide one; but the facts and observations are fitted into one another so as to produce a broad geographical impression. Even children will be attracted by the comparison between the jerboa and the horse, as animals requiring speed (p. 65), or between the birds and mammals of forest regions (p. 115), which select either an arboreal or a shelter-taking

policy. Marine life is treated with the advantage of very recent researches; but we doubt if irregular echinoderms are rightly styled "old-fashioned." Is not the author thinking of the extinct but regular Palæozoic forms? The illustrations of carnivores from paintings by W. Walls are the finest in a most interesting book. Teachers of geography and lovers of animal life will alike rejoice in it.

(5) Mr. Howarth has undertaken a hard task in giving a compressed picture of the commercial activity of the world. Such a work, however well done, cannot help reminding us of the lists of capes and rivers that once posed as lessons in geography. It is impossible to correlate all the details with the physical conditions of the country which they concern. The excellent description of the industries of Sheffield (p. 95) shows what the author would give us in a more limited field or in a series of such volumes. Even among the mere statements of facts, such as "*Zinc* is an important mineral product of Germany, Belgium, the United States, and elsewhere," he hits upon something that makes us think; why, for instance, are precious stones "in great part products of hot countries"?

GRENVILLE A. J. COLE.

TEXT-BOOKS OF PHYSICS.

(1) *Mechanics and Heat: an Elementary Course of Applied Physics.* By J. Duncan. Pp. xiii + 381. (London: Macmillan and Co., Ltd., 1913.) Price 3*s.* 6*d.*

(2) *Experimental Science.* I., Physics. By S. E. Brown. Pp. viii + 272. (Cambridge: University Press, 1913.) Price 3*s.* 6*d.*

(3) *Practical Physics for Secondary Schools.* By N. H. Black and Dr. H. N. Davis. Pp. ix + 487. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 5*s.* 6*d.* net.

(4) *A Text-book of Physics.* Edited by A. Wilmer Duff. Third edition revised. Pp. xvi + 686. (London: J. and A. Churchill, 1913.) Price 10*s.* 6*d.* net.

(5) *A Systematic Course of Practical Science for Secondary and other Schools.* Book II., Experimental Heat. By A. W. Mason. Pp. vii + 162. (London: Rivingtons, 1913.) Price 2*s.* 6*d.* net.

(6) *Paul Drudes Physik des Aethers auf Elektromagnetischer Grundlage.* Zweite Auflage. Neu bearbeitet von Dr. Walter König. Pp. xvi + 671. (Stuttgart: F. Enke, 1912.)

(1) THE object of Mr. Duncan's text-book, according to the preface, is to awaken interest in the applications of the principles of mechanics and heat to engineering and allied constructive arts. The author has compiled a well-arranged course of experimental work and descriptive matter in mechanics and heat, and, being an engineer, the applied side of the subject is kept well in the foreground. The first eleven chapters are devoted to mechanics, and contain, in addition to the more or less academic part of the subject, chapters on simple mechanism and hydraulic machines. The remaining ten chapters deal with heat, the action of the steam engine and the internal combustion engine being presented in a very simple and lucid manner, and well illustrated by clear diagrams. It may be regretted that Mr. Duncan could not have included some of the more modern methods of thermometry in the section on temperature, the principles and construction of many of the instruments employed being quite intelligible to elementary students. The subject of thermal conductivity, too, is barely touched upon, and as lagging is of extreme importance to the engineer, the value of the book would have been considerably increased by the inclusion of a few well-chosen experiments on this subject.

The book can be strongly recommended to first year students in technical institutes, and there is much in it that the average boy in the upper forms of a secondary school will appreciate. His interest in physics will certainly be stimulated by having the action of the cycle-motor and the motor-car engine so lucidly explained. Teachers of physics in schools may, however, object to the use of British units—lb., ft., ° F.—and the physicist does not usually determine the latent heat of water by plunging a piece of ice weighing $\frac{1}{2}$ lb. in $\frac{1}{2}$ gall. of water. Objection may also be made to this constant being termed the latent heat of ice. An excellent feature of the book is the questions and exercises appended to each chapter.

(2) The volume on physics by S. E. Brown is the first part of a course on experimental science for use in secondary schools; part ii. is to deal with chemistry. The present book is divided into four sections, viz., (1) measurement, (2) hydrostatics, (3) mechanics, (4) heat. The author supposes a boy to spend from two to three years in working through the book, and this, in conjunction with the chemistry course, should prepare him fully for such examinations as the experimental science of the Junior Locals or the Army Qualifying Examinations. As is now usual in books of this character, the manual may be used either in the laboratory or the class-room. The experiments are well selected, and great care has been taken in the preparation of the volume. We do not, however, like such statements as that on p. 3, where, in explaining how to use a scale for measuring lengths, we have the direction: "Put

one end of the object to be measured exactly opposite to the first unit mark"; the position of both ends of the object should be read off, the fraction of a division being estimated by the eye. We cannot agree with the author's claim on p. 194 that the apparatus described for measuring the expansion-coefficient of air at constant pressure gives better results than any form usually employed in schools. He has in the example cited a movement of the mercury column of 4·93 cm., and it would be very difficult to estimate this exactly to more than 1 mm. There is confusion in the definition of thermal conductivity, the expression "a centimetre cube" would have been better than "a cubic centimetre," and the coefficients of thermal conductivity in the table on p. 245 are not in calories. The large number of questions and numerical exercises should prove a great boon to many teachers.

(3) "Practical Physics for Secondary Schools," by Black and Davis, is not a laboratory manual, but what in England would probably be termed a "Text book of Elementary Physics." The authors, in the preface, state that in preparing the volume they have tried to select only those topics which are of vital interest to young people, whether or not they intend to continue the study of physics in a college course. They believe that everyone needs to know something of the working of electrical machinery, optical instruments, automobiles, vacuum cleaners, fireless cookers, &c. It must not be thought, however, that the fundamental principles of physics have been neglected; Messrs. Black and Davis have succeeded in producing a very clear and interesting text-book. In the chapters devoted to optics we have the proof of the mirror formula, $1/D_0 + 1/D_1 = 1/f$, but in the case of the lens the authors state the same formula holds. We should like to have seen it made more explicit as to the signs of the terms in the various cases which may arise. Fig. 444, combining spectral colours into white light by aid of a convex lens, is obviously wrong. The book contains a large number of questions and numerical exercises, and there is much useful information in it which should prove of extreme value to a teacher, but it is scarcely suitable for adoption in English schools owing to its American style.

(4) The first edition of Duff's "Text-book of Physics" appeared in 1908, and was compiled by the collaboration of seven teachers of physics in the universities and polytechnic institutes of the United States. In this third edition the sections on heat and electricity and magnetism have been re-written, and are greatly improved. Prof. Mendenhall is responsible for the section on heat, and Prof. Carman for that on electricity and magnetism. Prof. McClung contributes a section on the conduction of electricity through gases. The text-book forms an excellent college course on physics, and though, in a single volume, the treatment of some points must of necessity be meagre, there are references at the ends of each section to the various standard text-books dealing with special branches.

(5) "Experimental Heat," by A. W. Mason, is a laboratory course of experiments for secondary schools, and thoroughly covers the syllabus of the Matriculation and Senior Locals. The book is well arranged, and each exercise is furnished with questions bearing on it. The answering of these by the pupil will certainly necessitate intelligent thought about the experiment he has performed.

(6) It is more than eighteen years since Drude's "Physik des Aethers" was published, the book being the outcome of a course of lectures on Maxwell's Electromagnetic Theory delivered by the late Prof. Drude at the University of Göttingen. Although the book did not aim at being a complete treatise on electricity and magnetism, it formed an excellent introductory course to the standard work of Maxwell. The mathematical treatment was simple, no further knowledge than the elements of the calculus and differential equations being demanded of the reader. In the new edition by Prof. W. König, although the scope of the book remains the same, considerable modifications have been made which greatly enhance its value as a text-book of electricity. The first portion of this second edition is devoted to electrostatic theory, the treatment of which was exceedingly meagre in Drude's original work. The section dealing with Helmholtz's "Action at a distance" theory has been omitted, and also the chapters bearing on optical phenomena from the electromagnetic point of view. These latter have been treated by Drude at much greater length in his more recent "Lehrbuch der Optik." The chapters on electrical oscillations have been amplified, the theory of coupled circuits being included. The author has found it impossible to deal with the electron theory within the compass of the book. An excellent portrait of the late Prof. Drude forms the frontispiece of the work.

OUR BOOKSHELF.

Underground Waters for Commercial Purposes. By Dr. F. L. Rector. Pp. v+98. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 4*s.* 6*d.* net.

The title of this book is rather misleading. Although the contents are interesting and useful so far as they go, the book cannot in any way be regarded as a text-book for those engaged in advising as to water supply or in carrying out works for storage and distribution for domestic use or for power purposes. The subjects dealt with are the storage and flow of underground water in porous soils, and the chemical properties of this water, but nothing is said as to how this underground water can be made serviceable.

The chapters into which the book is divided relate to:—the source and flow of underground water; springs and wells; the chemical, bacteriological, and microscopical examination of underground water, together with rules and tables relating to water, and a bibliography of books bearing on the subjects dealt with.

The author does not attach much importance to the quality of water so far as what is generally termed "hardness" is concerned, due to the presence of lime, on the ground that the quantity contained in the water is so small "that it would be necessary to drink gallons of such water at a time in order to get enough to have any effect upon the system." Whatever may be the case in America, the country where the author's experience has been obtained, here it is generally recognised that water containing lime is very injurious to any constitutions subject to complaints such as gout or rheumatism. Such water when boiled leaves a solid deposit on the bottom of the vessel in which it is contained. The effect on domestic boilers is very deleterious, and necessitates frequent scaling to remove the encrustation that takes place on the surface in contact with the water. The encrustation also of boilers used for producing steam for power purposes is a very serious objection to the use of hard water when it can be avoided.

Outlines of Mineralogy for Geological Students. By Prof. G. A. J. Cole. Pp. viii+339. (London: Longmans, Green and Co., 1913.) Price 5*s.* net.

As its name implies, this book is "primarily intended for those who are interested in geology, and find themselves in need of an introduction to the classificatory details of the larger works of reference." Within the limits of 330 pages of fairly large type Prof. Cole has produced a textbook which, so far as it goes, is trustworthy, interestingly expressed, and based upon the now firmly consolidated modern ideas of crystal structure and symmetry. It has the further recommendation that it indicates, by footnote references, those larger works or original memoirs from which further detailed information may be obtained as regards both theoretical elaborations and experimental processes and measurements. Moreover, the greater number of these references are to works of very recent date, and it is obvious that the author has followed the rapid recent developments of the crystallographical part of his subject with care and keenness. Hence this book will form a safe and inspiring guide to students embarking on the study of mineralogy for the purpose of eventually utilising their knowledge in the field; and although such an object is not specifically indicated by the author, the use of the book can scarcely fail to produce the good effect of interesting the would-be mining engineer in the pure science of the subject, and possibly of inspiring some original work.

As regards the half of the book devoted to descriptive mineralogy, a point of special excellence is the manner in which the phenomena of isomorphism and of the periodicity and family resemblance in the relations of the chemical elements are maintained prominently in view throughout. Also the especially able treatment of the silicates, so important to the geologist, which one would naturally expect from Prof. Cole, is a commendable feature of the book. While the letterpress is thus of general excellence so far as its very limited outlook is concerned, it is to be regretted that such illustrations as are new (many of the figures being older ones borrowed from H. Bauerman's "Systematic Mineralogy" issued by the same publishers) could not have been of a higher character; while perhaps adequate for their purpose, they are by no means worthy of so well written a book.

The Elements of Descriptive Astronomy. By E. O. Tancock. Pp. 110+xv plates. (Oxford: Clarendon Press, 1913.) Price 2*s.* 6*d.* net.

This little book may profitably be placed in the hands of boys beginning to take an intelligent interest in the heavens. Facts are given mostly with accuracy, and stated clearly in simple phrasing. There are many half-tone reproductions of interesting celestial photographs, and the text is helped by numerous instructive line diagrams. We may mention No. 13, which excellently *explains* the different noonday altitudes of the sun at summer and winter solstices. Efforts are made throughout to lead the reader to observe and think. A feature of the book consists in a small collection of quotations of an astronomial character for the reader to explain. There are some blemishes which may perhaps be remedied in another edition. Thus the bulk of Saturn is incorrectly "deduced," and its aplatissement is much greater than that of Jupiter; also, eight significant figures are misleading when employed in expressing the distance from the earth to the nearest fixed star; and Praesepe might be mentioned as suitable for observation with a small telescope.

H. E. G.

A National System of Education. By J. H. Whitehouse, M.P. Pp. 92. (Cambridge University Press, 1913.) Price 2*s.* 6*d.* net.

This book is welcome as an indication that our legislators are becoming not only more interested in national education, but also better informed as to English educational needs and shortcomings. These brief chapters on all grades of education, and on many problems which demand an early solution, will serve admirably to instruct ordinary citizens as to the duty of the State towards education.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Plumage Bill.

I HAVE read with much interest Sir Harry Johnston's article in NATURE of December 11 (p. 428) on the Plumage Bill proposed to be introduced next session into Parliament. I agree in the main with him that the Bill does not give as much satisfaction as was hoped for to "root and branch reformers," for it exempts from supervision personal clothing worn or imported bv individuals entering this country from abroad. Consequently a woman resolved to have headdresses and robes of forbidden plumage has only to purchase such abroad and stick it into her apparel or her hat and she passes our Customs houses unchallenged.

This weakness in the Bill can surely be eliminated by making the *wearing* of wild birds' feathers in England by British subjects as illegal as the importation of the feathers. If no feathers can be introduced, it is obvious that anyone wearing them is act and part in their introduction, and the contraband is therefore subject to seizure. In any case, the Customs officers may examine any luggage suspect of concealing contraband plumes, and confiscate the feathers in the hat or dress of any subject when a law to the effect comes into force, just as they can now with any other species of contraband. It seems an absurdity to disallow the import of feathers, and yet allow them to be flaunted openly in the street. Of course, *foreign* visitors wearing feathers in England could not be legitimately interfered with; but it would be illegal for them to sell or dispose of the same in this country. Yet it would matter little if the *wearing* of plumes by British subjects were illegal. I think the American law, by which feathers worn by foreign visitors to the States, in whose country the custom is legitimate, are seized, is indefensible. It is all right when applied to its own subjects; but to foreigners it is nothing short of legalised assault and insult. How would a Maori chief, with the huia feathers distinctive of his rank in his hair, be dealt with?

Such a case as the Nipal trade could, as Sir Harry Johnston indicates, be easily blocked either at the frontier or at the Calcutta Customs House, and regulated in the same manner as the trade in opium or arms is.

As a British ornithologist, I hope Sir Harry will allow me to take exception, if I do not misunderstand him, to his charge of lukewarmness against our union in respect to this Bill. The union may contain a few opponents of the measure—they are chiefly egg-harriers—but the attitude of the great majority of its members most certainly is not that "so long as museum shelves are stuffed with specimens birds may be in the landscape or not." Only a few of the members have private collections or are museum conservators. At the last largely attended meeting of the club, a few days ago, approbation was universally extended to one of our members for having, by the expenditure of much time and with infinite patience, tried to identify by aid of his binocular a rare visitor to a certain part of England, instead of "collecting" it, which he could easily have done, and so spared himself, at the expense of a charming addition to the fortunate locality.

Is Sir Harry not rather inconsequent in asking why should there be any more killing of birds and beasts, and relegating their life-study to the camera, while reminding his fellow-ornithologists "that it is not only the skin of the bird for classification that is needed, but still more the bones, the muscles, and the viscera and the living creature itself"? I fear he cannot get these omelettes without breaking the eggs! A long series of skins is, moreover, now considered necessary for the real study of species. I may associate Sir Harry with myself as men who have collected largely, in affirming that the real scientific collector and lover of birds, who is also an exterminator of species, is a very rare person. Anyhow, over-destruction of animals for scientific purposes can be easily regulated by licence. Neither plume-hunters nor wardens can replace the scientific collector in obtaining materials for investigation.

The real object desired by the Royal Society for the Protection of Birds is the prevention of the great cruelty for which the plumage trade is responsible, of the extermination, and of the reduction towards that point of the beautiful and beneficent fauna of the world. America by her draconic law has the credit of beginning the war against extermination on effective principles. The evil must be scotched, both at the source and at the terminus of the trade. If England and her possessions prohibit the export, import, and wearing of plumes, assisted by Germany and Austria (and I understand they desire to cooperate with this country in the matter), the fashion for wearing feathers would die out notwithstanding the open market of Paris and Antwerp, and with it this nefarious trade. Where a species becomes so numerous as to cause loss to the agriculturist, it would be easy enough to give special licence for its destruction *without leave to export the skins*, for then there would be no inducement to kill more than might be necessary to "abate the nuisance." Against "discriminating reasonably" and allowing others so procured to be exported there could be no objection, if it were possible; but the Customs officers would then require to be trained ornithologists. The difficulty of determining a scheduled species is extremely difficult, and has been the cause principally of the failure of our Counties Bird Protection Bill.

All "root-and-branch reformers" in this matter are more than grateful to Sir Harry Johnston for his constant advocacy of a Bill that shall be effective to preserve the beautiful and useful animals of the world in face of the opposition of a "barbarous industry."

HENRY O. FORBES.

Redcliffe, Beaconsfield, December 14.

Intra-atomic Charge and the Structure of the Atom.

I AM very grateful to Mr. Soddy (NATURE, December 4, p. 399) that in accepting in principle the hypothesis that the intra-atomic charge of an element is determined by its place in the periodic table, he directed attention to the possible uncertainty of the absolute values of intra-atomic charge and of the number of intra-atomic electrons. Surely the absolute values depend on the number of rare-earth elements; but if to the twelve elements of this series, the international table contains between cerium and tantalum, the new elements (at least four) discovered by Auer von Welsbach in thulium (*Monatshefte für Chemie* 32, Mai, S. 373), further keltium, discovered by Urbain (*Comptes rendus d. l'Acad. des Sciences*, 152, 141–3), and an unknown one for the open place between praseodymium and samarium be added, this long period, too, becomes regular. Moreover, if only twelve instead of eighteen elements existed here, the ratio of the large-angle scattering per atom divided by M^2 is no longer constant, the values for copper, silver, tin, platinum, and gold then being 1·16, 1·15, 1·19, **1·26**, and **1·24** respectively, instead of 1·16, 1·15, 1·19, **1·17**, and **1·15**; and the same holds for the following relation concerning the number of intra-atomic electrons.

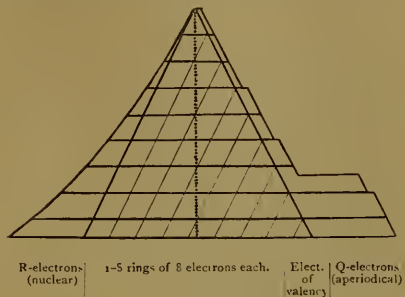
The irregularities in Mendeléeff's system—rare-earth series, complexity of group VIII., and this group, as well as group O being only half-groups—may be removed by putting hydrogen and helium (as components) outside the table, and condensing each triad of Group VIII. into one place alternating with the rare gases, and likewise all elements from cerium to tantalum into one place. For this "condensed" system, with a constant period of eight places and a constant long period of sixteen, the relation $(A-2M)/kP^2$ = constant, holds as exactly as for mean values of A, the possibility of different components taken into account, may be expected. (P is for the condensed system what M is for Mendeléeff's, and k is a constant.) If now M is the number of electrons of the negative intra-atomic charge, and A/2 (if the mass of the atom consists of α particles for by far the greater part) the total number of electrons per atom, then kP^2 must be the number of electrons, making up, together with the α particles, the positive intra-atomic charge (nuclear electrons).

	C	Mg	Ar	Cr	Zn	Kr	Mo	Cd	Xe	W	Hg	U
M... ...	6	12	18	24	30	36	42	48	54	78	84	96
P... ...	4	10	16	22	26	32	38	42	48	54	58	70
kP^2 ...	0	0	1	2	3	5	6	8	11	14	16	23
A (calc.)	12	24	38	52	66	82	98	112	130	184	200	238
A (exp.)	12	24	40	52	65	82	96	112	130	184	200	238

A (calc.) $= 2(M + kP^2)$; $k = 0·00468$.

I agree with Mr. Soddy that the number of these electrons, or the components, or both, must be different for different members of the same element, and, as atomic weight, a mean value. But it seems doubtful whether other components than the α particles can be present in atoms in any appreciable amount, for of eighty-three elements no fewer than thirty-one have atomic weights of the type $4n$ (from $3·51+4n$ to $4·50+4n$), and twenty-nine of the type $3+4n$ (from $2·51+4n$ to $3·50+4n$, n being an integer), and if all radio-active substances be included (the atomic weights of the uranium family being calculated from those of uranium, radium, and lead, and actinium considered as a branch product of the uranium family), then from 114 atomic weights forty-one belong to the $4n$, fifty to the $3+4n$ series, and only twenty-three, instead of fifty-seven, to the two other types. Should particles of atomic weight one, two, three, or more, or other not being a multiple of H—for example, such as proposed by Nicholson (*Phil. Mag.*, vol. xxii., 1911, p. 871)—be mixed up with the α particles in comparable amount, then this distribution would be very improbable. Perhaps one particle of mass $\frac{3}{4}\alpha$ (J. J. Thomson's X_3?) only, is present in the $3+4n$ series, and none but α particles in the $4n$ series. Of course, other components are not impossible, but at least the members of each radio-active family must have the same components, and if actinium is a branch product of the uranium family, then here only members of the two series $3+4n$ and $4n$ are present. The periodic systems proposed previously (*Physik. Zeits.*, vol. xii., p. 490, and vol. xiv., p. 32) might then be systems not of elements, but of all possible atomic substances.

If then A/2 is the total number of electrons per atom, $kP^2 = R$, that of the electrons of the intra-atomic positive charge, P that of the electrons arranged periodically, say in rings of eight electrons each, with a rest of electrons of valency, and $M-P=Q$ that of the electrons arranged aperiodically (as are the elements excluded from the "condensed" system), we get this scheme of electronic distribution, in which R is given on the left of P, and Q on the right, and the horizontal lines indicate the numbers of electrons in each and the atomic weight, while the dotted line gives the elements (each dot representing an element of the condensed system, and eight a period), and at the same time the scale for the numbers of electrons in the horizontal lines, each dot then representing one electron.



Distribution of intra-atomic electrons.

After the foregoing had been written, a letter appeared on the same subject from Prof. Rutherford (NATURE, December 11, p. 423). My letter was, indeed, not supposed by me to give any rectification of the theory of the positive nucleus as proposed by Prof. Rutherford. Nor did I suppose the idea that the nucleus might contain electrons to be new. Moreover, a cluster of α particles only may still be at the centre of the atom surrounded by some rings of electrons of a diameter smaller than $3·10^{-12}$ cm. These rings may have no influence at all on the properties of the elements, and for an electron penetrating from without will belong to the nucleus, while for an electron ejected from the innermost ring they will not. So the characteristic radiation depends on M and not on A. This was proved by Moseley (*Phil. Mag.*, vol. xxvi., 1913, p. 1024; the first direct proof) to hold for the elements from calcium to zinc, but seems to hold for all. If the logarithm of μ/d(Al) be plotted against the logarithm of M, all the points lie on a straight line for the "K," and on another for the "L" radiation, the two lines being apparently parallel. The same holds for the values given by Laub (*Physik. Zeitschr.*, vol. xiv., 1913, p. 992) for the "I" radiation. The Al radiation, μ/d(Al) = 580 cm.^{2}, g^{-1} seems to belong to still another series.

Likewise, Widdington's law holds better for $2M.10^8$ than for $A.10^8$ cm./sec., though, of course, for elements of low atomic weight the difference of M and A/2 is small; but for elements from Te upwards this difference is 20 per cent. and more.

Table II.

	Cr	Fe	Ni	Cu	Zn	Se
v min./0·995 A.10^8	0·98	**1·05**	1·05	0·99	0·98	**0·94**
M	24	26	28	29	30	34
v min./2·167 M.10^8	0·98	**1·03**	1·01	1·00	**0·98**	1·00

But the γ radiation for M = 86 (lead, &c.) in the neighbourhood of the "L" values ranges from μ/d(Al) = 11·4 to μ/d(Al) = 85 (Rutherford and H. Richardson, *Phil. Mag.*, vol. xxvi., p. 946), and is different for "isotopes."

Hence an electron penetrating the atom must pass the region of the "M" electrons, to excite, if of the required velocity, the outer rings of what, from a chemical point of view, might be called the nucleus, and, the radiation depending on the charge within the ring, and this charge being equal approximately to the number of electrons surrounding the ring, both will depend on M (see Bohr, *Phil. Mag.*, vol. xxvi., 1913, p. 476, and Moseley, *loc. cit.*). But a β particle ejected from the innermost ring must pass all other rings, and excite radiation different for each ring and for each "isotope," as dependent on the charge within, *i.e.* on nearly A/2, on M, on P, and so on, and lose quanta of energy proportional to the square of M, P, &c. Indeed, for Ra C ("K" radiation)

$$2m.M^2.10^{16} = 0{\cdot}8 \times 10^{13}e(M.=88), \text{ and}$$
$$2m.P^2 10^{16} = 0{\cdot}4 \times 10^{13}e(P=62),$$

in agreement with the quanta, calculated by Rutherford. (For these velocities $m/2V^2$ will nearly give the energy of the β particle.) Besides, the "L" radiation of Bi being about equal to the "K" radiation of As (P=29), another quantum

$$m/2(58.10^8)^2 = 0{\cdot}09 \times 10^{13}e,$$

may be expected, and can indeed be calculated from Rutherford's tables (*Phil. Mag.*, vol. xxvi., 1913, p. 725).

But even then the nucleus might contain electrons. If the particle should, as probable, consist of 4(H+) and 2 electrons, and the particle X_3+ of 3 (H+) and 2 electrons, the number of electrons and of H+ particles should both be equal to the atomic weight. But then the diameter of the positive unit could certainly not be greater than the diameter of the electron (10^{-13} cm.), and it might, indeed, be an electron too, but in a different state, and be a particle with a net positive charge.

A. van den Broek.

Gorssel, Holland, December 12.

Wind Provinces.

Several meteorologists have shown recently that the wind directions in the neighbourhood of cyclones and anticyclones are not of the simple nature that is sometimes supposed. Indeed it would seem that at any moment, if we consider an area large enough, the winds may be separated into distinct provinces over which they blow with great steadiness as regards direction.

Fig. 1 shows these *wind provinces* for the North Atlantic and the European and East Asiatic areas for October 25. No doubt near the surface of the earth the winds are more complex in their distribution than they are in the free air. The wind directions and isobars are taken from the Weekly Weather Report, and the long and short dotted lines separate one wind province from another. The greatest irregularities in the direction of the wind occur near mountain chains, and where rain is falling and producing local currents in the lower atmosphere.

Fig. 2 shows the wind provinces over western Europe at 8 a.m. on November 13, 1901. The wind directions shown by the arrows are from plate vii. of "The Life History of Surface Air Currents," by Shaw and Lempfert. Here we have the winds of three provinces flowing towards or influenced by the cyclonic centre. At 6 p.m. the centre had moved about one mile to the east, heavy rain fell over Europe, and the wind in the rainy area became more variable in direction. The rain of this cyclone appears to have been largely due to the wind of the south-south-westerly province bunching up against and mounting over the wind of the east-north-easterly current. Cave is of opinion that rain is very frequently the result of one wind rising over another in this manner. Thus a north-easterly wind may have an upper south-westerly rain-bearing wind blowing over it, adiabatic expansion and condensation being due to the rise of the air and only slightly to the lower pressure of the cyclonic centre.

From Fig. 1 it would appear that winds which are at the earth's surface at one place must often be upper winds at other places. Occasionally no doubt the line separating two provinces is where the wind undergoes a rather sudden change of direction under the influence of an advancing depression; for the

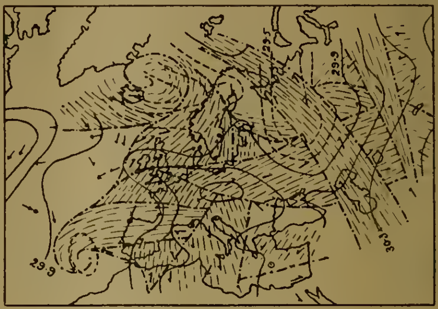


Fig. 1.—Wind Provinces, Oct. 25, 1913.

cyclone as it advances, although it changes the direction of the wind, does not carry any particular mass of air very far from the position in which it found it. An interval of twenty-four hours is generally sufficient to alter very greatly the distribution of pressure, and, therefore, also of the wind provinces.

Shaw and Lempfert, in their "Life History of Surface Air Currents," have shown that the actual path

Fig. 2.—Wind Provinces, Nov. 13, 1901.

of the air is not that which might be gathered from the wind charts; for the distribution of pressure and the arrangement of the wind provinces, change entirely in many cases, long before a mass of air could pass from an area of high pressure to one of low pressure. However, they prove that there is an actual rise of the air near a cyclonic centre capable of producing adiabatic expansion and the fall of rain.

It may be that if each day, or, better still, twice each day, a more detailed map of the wind provinces were drawn, and as much information of the upper currents obtained as possible, it would assist to elucidate many obscure questions relating to rainfall.

Of late years the steady improvement of the charts given in the Weekly Weather Reports of the Meteorological Office has been very noticeable. If the charts were twice the size and the evening observations dealt with as fully as the morning, a great step in advance would be made.

R. M. DEELEY.

Abbeyfield, Salisbury Avenue, Harpenden, November 13.

Amœbocytes in Calcareous Sponges.

WHEN Prof. Dendy, in NATURE of December 4, writes that "the Amœbæ referred to by Mr. Orton . . . possibly . were . . . metamorphosed collared cells," he must have failed to notice the dimensions given by Mr. Orton.

A cell "with slightly rounded ends" "80 μ long and 40 μ broad," and (say) only 10 μ thick, would contain some sixty of even the large collar-cells of *Grantia compressa*.

GEO. P. BIDDER.

Cavendish Corner, Cambridge, December 14.

MR. BIDDER is perfectly right. The Amœbæ described by Mr. Orton are far too large to be metamorphosed collared cells or even young amœboid germ cells. The only cells in the sponge (*Grantia compressa*) which compare with them in size are the full-grown oocytes, and although these are amœboid and put out long pseudopodia, it is scarcely likely that they would find their way into the gastral cavity, as I have never seen them except in the mesoglœa between the chambers. My data, from which the actual size of the amœbocytes could be calculated, were not at hand when I wrote my letter, and as I had been working with a magnification of 1650 diameters, my ideas of a "rather small" Amœba had come to differ considerably from Mr. Orton's. Knowing how abundant amœbocytes frequently are in the flagellated chambers of the sponge it seemed almost certain at first sight that any obtained from the gastral cavity would be of the same nature, but evidently I was mistaken, and I am much obliged to Mr. Bidder for directing my attention to the fact.

ARTHUR DENDY.

University of London, King's College, December 16.

Reversibility of Ferment Action.

IN NATURE of December 4 last there is a letter from Sir Lauder Brunton, correcting a misstatement in a former issue in connection with a paper by Prof. Bourquelot on the reversible nature of ferment action.

Sir Lauder Brunton's letter points out a mistake that might have been prejudicial to me; but your original article was not quite fair also to Prof. Bourquelot, for he, so far from claiming priority for himself, gave me in his paper full recognition.

Since I first showed that the action of a ferment was a reversible one, many observers have done confirmatory work. The earliest to do so were Profs. Kastle and Löwenhart, of the United States, and among the more recent, Prof. Bayliss in this country has done valuable work.

I am glad that Prof. Bourquelot by his own good work has become convinced.

ARTHUR CROFT HILL.

169 Cromwell Road, S.W., December 19.

THE ORIGIN OF CLIMATIC CHANGES.

THE discussion of meteorological observations shows clearly that climates undergo variations of short duration, but such records as the presence of old lake beaches and the existence of well-marked glacial moraines, and other geological evidence distinctly point to climate changes covering long intervals of time. The evidence is not sufficient to characterise the variations as periodic, but the ice ages are sufficient to point to times when the conditions reached were extreme.

What may reasonably be assumed to be the chief established facts about such extensive changes may be summed up briefly as follows:—Climatic changes were several, and probably many. Similar simultaneous changes occurred over the whole earth, or, in other words, it was warmer or colder over the whole earth simultaneously. These times of warmth or coldness were unequal in intensity and duration, and of irregular occurrence, and, lastly, they have taken place from very early, if not from the earliest geological age down to the present. Numerous theories, both probable and improbable, have been suggested from time to time to account for the origin of such world-wide changes, and while each has its advocates, perhaps only three may be said to claim attention to-day. These may be briefly stated as the Eccentricity Theory (Croll), depending on the eccentricity of the earth's orbit; the Carbon Dioxide Theory (Tyndall), based on the selective absorption and variation in amount of carbon dioxide; and thirdly, the Solar Variation Theory, on the assumption of solar changes of long duration. A new theory, which may be called "The Volcanic Dust and Solar Variation Theory," has recently been put forward by Prof. W. J. Humphreys,[1] under the guarded heading, "Volcanic dust and other factors in the production of climatic changes, and their possible relation to ice ages."

The author carefully points out that the idea that volcanic dust may be an important factor in the production of climatic changes is not new, but "though just how it can be so apparently has not been explained, nor has the idea been specifically supported by direct observation." He remarks also that while the pioneers regarded the presence of volcanic dust in the atmosphere as an absorbent of radiation, and so lowered the earth's temperature, modern observation suggests the opposite effect, namely, the warming of the earth's surface.

In putting forward his views of the action of dust, Prof. Humphreys proceeds first to indicate that the dust that is effective is that which is situated in the atmosphere in the isothermal region or stratosphere. He then enters into the question of the size of the particles and probable time of fall, and concludes that particles of the size 1·85 microns in diameter would take from one to three years to get back to the earth if

[1] Journal of the Franklin Institute. August, 1913, vol. clxxvi., No. 2, p. 131; also Bulletin of the Mount Weather Observatory, August, 1913, vol. vi., part 1, p. 1.

they originally had been thrown up by a volcanic eruption.

Considering next the action of the finest and therefore most persistent dust on solar radiation, he finds that the "interception of outgoing radiation is wholly negligible in comparison with the interception of incoming solar radiation."

Prof. Humphreys now turns his attention to the observational evidence of pyrheliometric records, such readings being functions of, among other things, both the solar atmosphere and the terrestrial atmosphere. He thus introduces a curve showing smoothed values of the annual average pyrheliometric values, and compares this with sun-spot frequency values (representing solar atmospheric changes) and number of volcanic eruptions (representing terrestrial atmospheric changes). The similarity of the last-mentioned with the pyrheliometric curve leads him to write as follows: "Hence it appears that the dust in our own atmosphere, and not the condition of the sun, is the controlling factor in determining the magnitudes and times of occurrence of great and abrupt changes of insolation intensity at the surface of the earth."

The action of the dust intercepting at times as much as one-fifth of the direct solar radiation leads him to inspect earth surface temperature values to inquire whether they are below normal on such occasions. The pyrheliometric and temperature curves suggest a relationship, but, as he states, "the agreement is so far from perfect as to force the conclusion that the pyrheliograph values constitute only one factor in the determination of world temperatures." A better agreement is secured when the combined effect of insolation intensity and sun-spot influence is considered.

The author then discusses the temperature variations since 1750 as influenced by sun-spots and volcanic eruptions, and indicates that the disagreement in the curves of temperatures and sun-spots is in every important instance simultaneous with violent volcanic eruptions.

Limitations of space will not permit us to remark on his references to the action of carbon dioxide in slightly decreasing the temperature or to probable great changes in level. Enough perhaps has been said to show that Prof. Humphreys, in his interesting attempt to show "that volcanic dust must have been a factor, possibly a very important one, in the production of many, perhaps all, past climatic changes . . .", has restarted a topic which will no doubt call for criticisms and discussions from many quarters.

BIOLOGY OF THE LAKE OF TIBERIAS.[1]

THAT natural history had its students among the ancient inhabitants of Palestine is clear from the book of the Levitical law and from the biography of King Solomon. But during the first century of our era there is nothing to show that the study excited the slightest interest in that locality. Fishes are mentioned for their economic use; mint, anise, and cummin as objects of taxation; the stars in the sky and the flowers of the field for their superficial beauty; crops are supposed to spring from dead seeds; pearls of impossible size are made the symbols of celestial splendour. It is only in modern times, and even now by strangers rather than natives, that a striking contrast to this apathy has been brought about. If the water of the Jordan is still carried westward for religious rites, samples from the Sea of Galilee are now collected with equal care for chemical analysis; Syrian Entomostraca are reared in England from mud out of the pool of Gihon at Jerusalem; from the Galilean lake, by the use of tow-nets, hand-nets, and special dredges, a varied fauna is obtained, such as might have excited the interested surprise of Solomon, but would probably have been viewed with disgust by the Sanhedrim of a later epoch.

Prof. Théodore Barrois, in his own interesting study of the Syrian lakes (1894), explains that the scientific exploration of them was begun in August, 1847, by Lieutenant Molyneux, R.N. By great efforts this officer succeeded in obtaining valuable hydrographical details, both in the lake of Tiberias and in the Dead Sea, only to succumb almost immediately afterwards to the exhausting effects of the climate, torrid and unwholesome at that season in the valley of the Jordan. In some future Dictionary of National Biography his name ought surely to find a place. His initial enterprise has been followed by the labours of many eminent naturalists. Dr. Annandale's present contribution to the subject was instigated by his desire to trace the genera of sponges and some other invertebrates "characteristic of the fresh waters of India and tropical Africa northwards up the Jordan valley, should they prove to have a distribution in any way similar to that of the Jordan fishes, whose African affinities have long been known." He concludes that "There is no reason to think that the sponge-fauna of the Lake of Tiberias is closely related to that of any other lake, but its affinities lie rather with that of Eastern tropical Asia, and possibly with that of the Caspian Sea, than with any in Europe and Africa."

His investigation of the Galilean fresh-water sponges leads Dr. Annandale to divide the Spongillidæ into two subfamilies, the Spongillinæ, in which microscleres are present, and the Potamolepidinæ, in which microscleres apparently are not produced. Of the former subfamily the lake of Tiberias provides only one species, the widely distributed *Ephydatia fluviatilis*, var. *syriaca*, Topsent. Of the latter it furnishes four species, allotted to two new genera, *Cortispongilla barroisi* (Topsent), only known from this lake, and *Nudospongilla reversa*, *N. mappa*, and *N. aster*, all new. These are described and figured, together with other species introduced for the sake of comparison.

Useful keys are provided for distinguishing the Galilean sponges one from the other, and for recognising various genera of the Spongillidæ.

[1] A Report on the Biology of the Lake of Tiberias. Series I. Journal and Proceedings, Asiatic Society of Bengal (New Series), vol. ix., No. 1, 1913.

The subject is rather intricate, as may be judged from the history of the genera Uruguaya, Carter, 1881, and Potamolepis, Marshall, 1883. In describing the latter, Marshall, it appears, confessed that its separation from Uruguaya depended only on a geographical consideration, one group being found in Africa, the other in South America. Yet now they are assigned to separate subfamilies. Dr. Annandale, however, admits that the recognition of his sub-family Potamolepidinæ "depends to some extent on the fact that no gemmules have been found in any species that can be definitely assigned to the genus Potamolepis," and that if in the future "gemmules be found in an undoubted Potamolepis with specialised gemmule-spicules that can be called microscleres, the genus would have to be transferred to the Spongillinæ." It is evidently a case in dealing with which the student must be specialised as well as the spicules. It will not interest the water board at Cardiff, which is reported to have cleared its pipes of a blockading sponge-growth simply by using a solution of common salt, without reference to systematic nomenclature.

As it is sometimes supposed that the influence of environment is all-sufficing for the origin of species and makes natural selection a needless hypothesis, it is worth while to quote Dr. Annandale's remark that "it is not unusual for two species that live together to adopt diametrically opposite means to attain the same end." This he illustrates by the case of *Cortispongilla barroisi*, notable for the possession of a well-defined and almost symmetrical central cavity, while *Nudospongilla aster*, which inhabits the same environment, is a peculiarly compact sponge without any trace of a central cavity. The explanation offered is, that "if the particularly well-developed exhalent system implied in the production of a central cavity opening by a large osculum is advantageous in getting rid of silt that has entered the sponge, a compact structure may be equally efficient in preventing the silt from entering at all."

In separate sections of the report several subjects besides sponges are discussed by Dr. Annandale and his collaborators, but to these justice cannot be done within the limits of this notice.

T. R. R. STEBBING.

PROF. P. V. BEVAN.

THE younger generation of Cambridge physicists and many others will have noticed with regret the announcement in last week's NATURE of the death of Prof. P. V. Bevan at the early age of thirty-eight. He had a distinguished scientific record, and his friends confidently expected for him a useful and fruitful career. Entering Cambridge University in 1896 he took up the study of mathematics, and in 1899 was fourth Wrangler. The following year he was placed in the first division of the first class in part ii. of the mathematical tripos. With this equipment he turned his attention to experimental physics, and commenced research in the Cavendish Laboratory under Sir J. J. Thomson. In 1901 he was appointed to a demonstratorship, to which lecturing duties were added in 1904, and in 1908 he became Professor of Physics at the Royal Holloway College, a post which he held till his death.

Prof. Bevan's earliest important research was a very complete investigation of the action of light on the rate of combination of hydrogen and chlorine, but after his removal to London he devoted himself to optics. Starting from the work of Prof. R. W. Wood on anomalous dispersion in sodium vapour, he extended it to the vapours of other alkali metals. He made a detailed study of the absorption spectra of the vapours of lithium and cæsium, mapping their principal lines, and testing the applicability of the various formulæ suggested by Kayser and Runge, Rydberg, and Hicks to the series of lines in these spectra. Both at Cambridge and in London Bevan was keenly interested in the religious life of the students. He was president of the Cambridge Nonconformist Union, and later took an active part in the student Christian movement, to the publications of which he was a contributor. His was a strong, vigorous, and genial personality, which won the affection of all the students with whom he came into personal contact.

A. W.

NOTES.

FOR several days Sir David Gill has been suffering from double pneumonia at his residence in Kensington. As we go to press we learn that though his lungs are improving and he maintains his strength, his condition is still critical.

DR. TEMPEST ANDERSON, whose death was announced in NATURE of September 4, has left 50,000*l*. to the Yorkshire Philosophical Society, of which he was formerly president, and 20,000*l*. to the Percy Sladen Memorial Fund, established by his sister, Mrs. Sladen, in 1904.

IT is proposed to present to the Royal Society a portrait of the retiring president, Sir Archibald Geikie. A small executive committee, with Sir William Ramsay as chairman, has been formed to carry out the preliminary arrangements and collect subscriptions, which it is agreed should range between one and three guineas. Promises amounting to about one hundred guineas have been received already from fifty fellows of the society. Subscriptions may be sent to the treasurers of the Geikie Portrait Fund, at the Royal Society, or paid direct to Messrs. Coutts and Co., 440 Strand, W.C., for the fund. The subscribers will constitute a general committee, and they will be called together at a later date to consider the choice of an artist and other matters.

THE valuable services rendered to public departments by the Royal Society were referred to by Sir Archibald Geikie in his recent presidential address (see NATURE, December 4, p. 405); but it was pointed out that though the society has acquired the character of a kind of central bureau of science, there has been no corresponding increase of financial support. Sir Joseph Larmor, in *The Times* of December 20, refers to two recent matters of national importance in which scientific advice was apparently not invited from the Royal Society or any other expert body. One case is that of the rearrangement of the lightning conductors on St. Paul's Cathedral. During the structural examination made in the past summer the iron bars, inserted at the instance of Benjamin Franklin, the originator of lightning-rods, were found; and it was recalled also that the protection of the cathedral had then (about 1780) been under the consideration of a special committee of the Royal Society. Sir Joseph Larmor asks, therefore, whether in the recent rearrangement the Royal Society, or the Institution of Electrical Engineers, or other expert public body conversant with electrical matters, was approached, or consulted, upon the matter. The other instance mentioned by him relates to the problem of the decaying stone in public buildings. It was recently reported that funds have been obtained from the Treasury, at the instance of the Office of Works, to institute a scientific inquiry on this subject, and it was proposed to move "the Foreign Office to inquire of the Governments of France, Germany, Italy, Greece, and America whether any man of science in those countries had evolved any treatment to combat this very serious evil." Here again it does not appear that the Royal Society, the Chemical Society, or the Society of Chemical Industry have been asked for advice on a national matter especially within their domain, or to provide the information which the Foreign Office proposes to collect from various Governments, though in these days of intimate international cooperation and rapid spread of information in science they could no doubt do so.

At the meeting of the Society of Antiquaries of Scotland on December 8, Mr. A. Henderson Bishop read a paper on his recent excavations in the Island of Oransay. The excavation of the MacArthur Cave at Oban in 1895 had revealed certain indications which seemed to point to the possibility of there having been a human occupation on or about the line of the 30-ft. beach at a time when the sea had not permanently retired from this level. The evidence, however, was much too meagre and insecure to admit of such a revolutionary theory being founded upon it, but that theory has now for the first time been demonstrated from the shell mounds of Oransay. The line of the beach was found on a contour of approximately 30 ft. round the hill, and the disposition of its constituents was exactly what might have been looked for as the result of powerful seas washing against the talus of food refuse. Very interesting was the attempted reconstruction of the configuration of the site at the time of occupation. What is now a turf-covered sandy hill, some 54 ft. in height, standing about 650 ft. from the present high-water mark, was then an elliptical peninsula washed round nearly the whole of its circumference by the sea and connected by the stone ridge of the beach with the rest of the island. Further, the excavation supplied exhaustive material for a picture of the culture-stage of the inhabitants, and the result is a demonstration of the existence in Scotland of a culture presenting an extremely close affinity to that discovered in the Pyrenees grottos by the late M. Piette, to which he has given the name Azilian. The characteristic implements of both sites are the same—flat harpoons of bone and horn, sometimes with one, sometimes with two, rows of barbs, and generally perforated near the base; shoe-horn-like chisels of deer horn, and bone pins, along with pieces of pumice-stone on which they were fashioned. Very striking was the large number of convex faceted chisels—about 1000 were found—hitherto unexplained, which are regarded as implements worn by gouging the mollusc of the limpet from the shell.

The death is announced, in his eighty-seventh year, of Mr. J. W. Wilkins, one of the pioneers of the telegraph system in this country.

We regret to see the announcement of the death on December 18, at seventy-two years of age, of the Rev. Edmund Ledger, professor of astronomy at Gresham College, London, from 1875 to 1908, and the author of several popular works and articles on astronomical subjects.

It is proposed to place a tablet suitably inscribed to commemorate Benjamin Franklin in the Church of St. Bartholomew the Great, West Smithfield—the parish in which he worked as a printer. Subscriptions for this memorial may be sent to Mr. E. A. Webb, rector's warden, 60 Bartholomew Close, London, E.C.

By the will of Mr. Arnold Friedlander the sum of 5000*l.* is bequeathed for a Cancer Research Fund, to be applied as his executors may direct towards increasing the knowledge of the cause, characteristics, and effects of cancer and allied diseases, and the best means of the prevention, alleviation, and cure thereof.

Prof. E. L. Trouessart, of Paris, and Prof. W. B. Scott, New Jersey, U.S.A., corresponding members of the Zoological Society of London, have been elected foreign members of the society. Prof. E. Ehlers, Göttingen, Mr. J. H. Fleming, of Toronto, and Dr. C. Gordon Hewitt, Ottawa, have been elected corresponding members of the society.

A leading article in *The Northern Whig* of December 19 reminds us that the day of publication was the centenary of the birth of Prof. Thomas Andrews, one of the most notable men whom Belfast can claim. The article gives an interesting and instructive summary of Andrews's career, and of the scientific work which won for him a place among the foremost discoverers of the Victorian era.

The twelfth general meeting of the Association of Economic Biologists will be held at Liverpool on December 30–31. Among the papers to be presented are:—"Some Observations on the Bionomics of *Glossina morsitans* in Nyasaland," Prof. R. Newstead, F.R.S.; "The First-stage Larva of *Hypoderma bovis*," Prof. G. H. Carpenter; "The Food and Feeding Habits of Some Game Birds," W. E. Collinge; "Pollination in Orchards," F. J. Chittenden.

In *Man* for December Mr. T. C. Hodson records a curious account of silent bargaining from India. When the person making an offer for a horse at a fair suggests a hundred rupees, he takes one finger of the person to whom the proposal is made under a sheet spread over both their hands, and whispers the work *pakka*, adding another finger for every additional hundred. Similarly, the word *dåna* denotes five rupees, and *sute* a single rupee. It is a gross breach of etiquette to disclose the price fixed while the fair lasts, and it is a question of honour that offers made in this way should be held final and binding.

MR. J. REID MOIR has reprinted from *The Field Club Journal* a paper on a flint workshop floor recently discovered at Ipswich. In it were found hammer-stones, cores, worked flints, flakes, and "pot-boilers," in great abundance and close association. Comparing these "finds" with specimens of the Aurignac type, now in the British Museum, it is clear that the Ipswich flints belong to the Palæolithic cave period, in the Lower-Middle Aurignacean age. Two important results follow from this discovery. In the first place, it disposes of the theory that all the people of this age were cave-dwellers. Here there is no cave, and the settlement was formed in the open. In the second place, the abundance of "pot-boilers" indicates that these people split their flints in the fire, and, when possible, used the fragments as implements. This is an easy process, as experiments show that when a flint is placed in the fire for about five minutes, cracks appear in different places, and then a sharp blow will shatter the stone into several pieces. Mr. Reid Moir infers from this discovery that there is no hiatus between the industries of the River-Drift and those of Neolithic man, a result of the first importance, if it is found to be verified by further excavation in eastern England.

IN a paper on fishes from the Madeira River, Brazil, published in the October issue of the Proceedings of the Philadelphia Academy, Dr. H. W. Fowler describes fifteen species, one of which is made the type of a new genus—as new to science.

AN obituary notice, accompanied by a portrait, of Dr. J. W. B. Gunning, late director of the Transvaal Museum, Pretoria, appears in vol. iv., part 2, of the Annals of the Museum. Dr. Gunning, who was born at Hilversum, Holland, on September 3, 1860, went to South Africa in 1884, where he at first practised medicine. Appointed director of the museum in 1898, he raised the Zoological Gardens, which form a part of that institution, to their present high status.

THE British Ornithologists' Club has issued a "Guide to Selborne" and "A Synopsis of the Life of Gilbert White," by Major W. H. Mullens, and published by Messrs. Witherby as No. cxc of the club's Bulletin. Both were prepared in anticipation of a visit to Selborne in connection with the twenty-first anniversary of the club; but the visit did not take place, owing to the death of Dr. P. S. Sclater. In the "guide" it is pointed out that on the monument to White in Selborne Church it is stated that his remains are interred in a grave adjacent to the wall to which the monument is affixed. As a matter of fact, it lies outside the north-east corner of the church, the discrepancy being due to the transference of the tablet from the exterior to the interior of the building.

AT a particularly opportune moment, when, as has been well said, "a wave of vitalism has passed over society owing to the pervasive eloquence of Bergson and other writers," appears a reprint of an address delivered by the late Prof. Emil du Bois-Reymond on neo-vitalism ("Ueber Neo-Vitalismus," pp. 60; Verlag von W. Breitenbach, Brackwede, price 1 mark), before the Prussian Academy of Sciences, on the occasion of the Leibnitz anniversary in 1894. This is a strong criticism of the vitalistic theories which du Bois-Reymond himself did so much to undermine in Germany, and more particularly of the views of Virchow, Bunge, and of Driesch himself, whose theories have recently found favour in certain circles in this country as a new philosophy, although they are but a recrudescence of those which he formulated in 1893. The strong condemnation by du Bois-Reymond of such views may be summarised in Schleiden's phrase, which is made the text of his address:—"The savage who calls a locomotive a living thing is not more unscientific than the investigator of nature who speaks of vital force in the organism." The new edition is edited, with the addition of useful notes, by Erich Metze.

AN account, by Mr. S. W. Kemp, of the Crustacea Stomatopoda (Squillidæ) of the Indo-Pacific region constitutes part i. of vol. iv. of the Memoirs of the Indian Museum. It is really, so far as the structure and relations of the adults are concerned, a monograph of the entire group, since in addition to a review of all the local forms it includes a list, with references and synonymy, of all the species described from other regions. Altogether, according to the author, 139 species and varieties of adult Stomatopoda are known, of which ninety-seven have their being in the Indo-Pacific. All these are critically compared and succinctly described, the author having investigated not merely the extensive collection in his own charge, but also select loan collections from the British Museum and other institutions. No new methods of classification are proposed, though emphasis is laid upon the value of the ischio-meral articulation of the raptorial maxilliped for a primary subdivision of recent Squillidæ; the characters employed in grouping the species are those furnished by the raptorial apparatus, the sculpture of the carapace terga and telson, the form of the abdomen, the size, form, and inclination of the eye, and to a certain extent the presence or absence of a mandibular palp. Masterly as is the "systematic" touch, equal skill and judgment are shown in the treatment of those larger biological problems that always confront the open-eyed systematist, and the style throughout is a model of lucidity. The ten fine plates by S. C. Mondul that illustrate the memoir are part of the Illustrations of the R.I.M. Survey Ship, *Investigator*.

THE final part of the "Lepidoptera Indica (Rhopalocera)" has now been published by Messrs. L. Reeve and Co., Ltd., completing the tenth volume of this important work. The task of describing the whole of the butterfly fauna of India was planned and begun by the late Dr. F. Moore in 1890, and since his death in 1907 it has been carried on by Colonel C. Swinhoe, in accordance with the lines originally laid down. The families, genera, and species of the Indian region are all fully dealt with, and more than sixteen hundred species are illustrated by life-sized coloured figures. The Indian region, as recognised by Dr. Moore for the purposes of this work, is bounded by the Himalayas on the north, the Suleiman and Hala mountains on the north-west, and Burma on the east. It includes Ceylon and the Andaman and Nicobar islands. Within these limits is found a butterfly fauna of great and varied interest, less noteworthy indeed than that of Indo- and Austro-Malaya, and far less rich than that of South America, but well deserving of the exhaustive treatment which it receives in the present work.

MR. IMMANUEL FRIEDLÄNDER, of Villa Hertha, Vomero, Naples, has published, with Dietrich Reimer, Berlin, a small quarto work of 110 pages, with nineteen plates and eleven maps, entitled "Beiträge zur Kenntnis der Kapverdischen Inseln." This gives the results of a journey made by him in the summer of 1912. After briefly summarising the literature and the maps of the Cape Verde Islands, giving some details of their history, of the climate, inhabitants, health relations, fauna, and vegetation, the author gives an account of his geological observations on the various islands. A valuable synopsis of the rocks collected on the islands by Stübel, Bergt, and Friedländer is contributed by Prof. W. Bergt, of Leipzig. The work should be particularly useful to anyone proposing to visit these islands, which, obviously, are worthy of further study. Mr. Friedländer has long been attempting to establish in Naples a Vulcanological Institute under international auspices, but since his plans have not met with all the support he hoped, he has determined to begin at once with a small private institute established by himself, but open to students of all nationalities. It is hoped to lend out instruments from the institute, and to publish as its organ a *Vulcanologische Zeitschrift*.

THE July number of the Journal of the College of Agriculture, Tokyo, contains an interesting paper by Osawa on the sterility in *Daphne odora*, Thunb. This species is a native of China, commonly cultivated in Japan, where it is completely sterile. The pollen and embryo sac development in two related wild Japanese species, *D. pseudo-mesereum* and *D. kiusiana*, were studied for comparison. The latter are fertile, even under cultivation, in Japan. In the microspore mother-cells of *D. odora* extra nuclei are frequently formed, and various other irregularities occur. Even mature pollen grains which reach the stigma fail to germinate. Megaspores are also formed, but the embryo sacs usually degenerate before completing their development. This species is thus sterile in both sexes. In the two fertile species the sporophyte number of chromosomes is eighteen, while in *D. odora* it is about twenty-eight. Osawa refers to the conclusion of Darwin that sterility may result from change of climate or from the effects of cultivation, as well as from crossing, and he also cites a number of sterile plants which are known or believed to have originated through mutation, as in the well-known case of *Œnothera lata*. The author concludes that the sterility of *D. odora* has been caused either by cultivation or by mutation. The change in chromosome number in this species, together with the absence of sterility in the other two species in cultivation, favours the latter hypothesis, which could be verified by determining whether *D. odora* is sterile in its original habitat.

THE monthly parts of *The Geophysical Journal* issued by the Meteorological Office for 1912 contain daily meteorological, magnetic, electrical, solar and seismic data for Kew and Eskdalemuir, meteorological and magnetic data for Valencia, and values of the wind components for certain hours for four stations. They also include the results of the investigations of the upper air, and other useful data. The units are based on the C.G.S. system; the reasons for adopting the centibar or millibar instead of the inch for barometric measurements are given in the preface to the 1913 edition of "The Observer's Handbook" published by the office. As all attempts at popularising these units will be welcome to most meteorolgists, we may take this opportunity of referring to a useful article by Mr. Bonacina in the September number of *Symons's Meteorological Magazine*, relating to the valuable work by Prof. Bjerknes on dynamic meteorology and hydrography (Publication No. 88 of the Carnegie Institution of Washington). Among Mr. Bonacina's interesting remarks it is pointed out that barometric readings in inches "no longer avail when meteorological data are employed *quantitatively, i.e.* to serve for the pre-calculation of ensuing atmospheric changes, in accordance with the avowed aim of the new method."

THE director of the Meteorological Service, Survey Department, Egypt (Mr. J. I. Craig), has recently published his report on the rains of the Nile Basin and the Nile flood of 1911, in the usual form, with tables and plates. For the whole year there was a general deficiency of rain, except in Kordofan, and on the White Nile. In a chapter dealing with the normal rainfall it is stated that the time of its distribution is more complex than has been supposed; the regional curves show that they include three separate distributions, instead of two, as usually supposed, and an attempt is made to give a simple explanation of the facts. As a whole, the flood of 1911 started early, but afterwards was late and poor; it improved in September, and "matters were not so bad as at one time they promised to be." The report includes some interesting notes on the regimen of Lake Victoria; the mean annual variation of its levels at various seasons is said to be only 28 centimetres (11 in.), but the surface rises and falls by much greater amounts, consequent on variations in the intensity of rain and evaporation from one year to another.

AN interesting notice of the late Prof. Milne appears in the last number (vol. xvii., part 3-4) of the *Bollettino* of the Italian Seismological Society. Dr. Martinelli refers to his ability as an organiser, to his two text-books on "Earthquakes" and "Seismology," to the seismographs with which his name is connected, and to the fact that he was a pioneer in almost every department of his science. The only noticeable omission is that of all reference to his useful work on the construction of buildings in earthquake countries.

In a circular just issued by the Bureau of Standards of Washington giving the fees charged for tests of apparatus intended for temperature and heat measurements, a considerable number of hints as to the best methods of use of such apparatus are given. These hints cover thermo-electric pyrometers, both with elements of platinum, platinum-rhodium, and of iron, nickel, chromium, and their alloys, platinum resistance thermometers, and radiation pyrometers of both the single colour type, and those using the whole radiation. The provisional temperature scale now in use at the bureau is indicated by the following melting points:—Tin, 232°; cadmium, 321°; lead, 327°; zinc, 419°; antimony, 630°; aluminium, 658°; a silver-copper alloy of composition Ag_3Cu_2, 779°; silver, 961°; gold, 1063°; copper, 1083°; nickel, 1450°; palladium, 1550°; platinum, 1755°; alumina, 2050°; tungsten, 3000° C.; and the following boiling points at atmospheric pressure:—Naphthaline, 217·9°, benzophenone, 305·9°; sulphur, 444·6° C.

When light is transmitted through a liquid in which a fine precipitate has just been formed, it is well known that the absorption due to the liquid increases with the time, while the proportion of polarised light in the scattered light at right angles to the incident beam decreases, both changes being due to the increase in size of the precipitated particles. A similar relation has long been suspected between the absorption of the atmosphere for the sun's rays and the degree of polarisation of the light of the sky. The question has been tested experimentally by M. A. Boutaric, of the University of Montpellier, and his results appear in Bulletin No. 7 of the Classe des Sciences of the Belgian Royal Academy for 1913. The intensity of solar radiation was measured by an Ångström pyrheliometer, and the proportion of polarised light in the light of the sky by a Cornu photopolarimeter. The measurements show conclusively that for the greater part of the radiation received from the sun the absorption due to the atmosphere is closely connected with the proportion of polarised light in the general light from the sky. When one of the two increases the other decreases. Selective absorption plays a relatively unimportant part except in certain well-marked regions of the spectrum.

In the Records of the Geological Survey of India (vol. xliii., part 1, 1913) Dr. L. L. Fermor contributes a preliminary note on garnet as a geological barometer, and on an infra-plutonic zone in the earth's crust. Observations on the Kodurite series of rocks in the Vizagapatam district led him to inquire why these garnetiferous rocks had been caused to crystallise as such rather than according to the norm, or standard, mineral composition of Cross and Iddings. He concludes that since the garnet rocks have a higher specific gravity than their norm calculated from the chemical analyses, they must have crystallised under greater pressure. "Therefore it seems legitimate to postulate the existence below the plutonic rocks (which are typically non-garnetiferous) of a shell characterised by garnets wherever a sesquioxide radicle exists." For this shell he suggests the term *infra-plutonic*. He considers that carbon existing as graphite in the higher zones of the earth's crust will probably be represented by diamond in the infra-plutonic zone on account of the high density of the latter mineral. It is thus deduced that garnet and diamond will be two of the characteristic minerals of the zone. A release of pressure over any portion of the infra-plutonic shell would allow the liquefaction of that part of the shell under the high temperature prevalent; such liquid rock, on being intruded into the higher zones of the crust, would then solidify under lower pressure as a plutonic rock.

In "A Theory of Time and Space" (Cambridge: Heffer and Sons, 1913, pp. 16) Dr. Alfred A. Robb gives a brief account of his investigation of the relations of time and space in connection with optics, which he hopes to publish before long in book form. His problem consists in reconstructing from the bottom the theory of relativity which, though much discussed, is "still in a condition of considerable obscurity." The chief part in Dr. Robb's mainly logical investigation is played by the idea of what he calls *conical order*. This means that there are pairs of instants, A, B, such that, though A is neither before nor after B, the instants A, B are not identical. According to the author's view, the only events which are "really simultaneous" are those which occur at the same place. Of events occurring at different places one is, generally speaking, neither before nor after the other. Only if it be abstractly possible for a person, at the instant A, to produce an effect at the instant B, is the instant B said to be after A. This is one of the fundamental definitions given along with a set of postulates. By means of these and certain additional postulates, Dr. Robb promises to develop a system of geometry based on the conceptions of "after" and "before," and thus to include the theory of space in the theory of time. If A is an instant of which I am directly conscious and B is distinct from, but neither before nor after A, then B, of which I can be aware only indirectly, assumes an external character. In short, it is an instant "elsewhere." All who are interested in the subject will desire to see these remarkable and radical ideas developed fully in the promised book.

Quick and at the same time trustworthy methods of quantitative analysis are amongst the most important desiderata of biological chemistry, and any additions to their number are to be welcomed. Dr. P. A. Kober's application of the nephelometer, an instrument first introduced into analytical chemistry by Richards, to the study of enzyme chemistry is a case in point. In recent papers from the Harriman Research Laboratory, New York, he describes the conversion of the Duboscq colorimeter into a nephelometer, which he uses to determine the amount of dissolved protein present in a solution by precipitating it as a suspensoid by a suitable reagent. Comparison with a standard containing a known amount of the precipitated protein enables the accurate estimation of very small amounts of protein. Having found suitable precipitants for various proteins—for example, sodium chloride for edestin, sulphosalicylic acid for casein—he is able to measure the amount of peptic, tryptic, and ereptic digestion with accuracy and speed. In a second paper (Journal Amer. Chem. Soc., 1913, vol. xxxv., 1546) the same author describes improvements in the micro-chemical method of forming copper complexes of amino-acids, peptides, and peptones in neutral or slightly alkaline solution, so that quantitative results can be obtained in dilutions of one part in 500,000. It is shown that very few other substances react with the reagent, and these can be easily removed by means of ammoniacal lead acetate. The method has been studied carefully in its application to blood, urine, and the measurement of proteolysis, and it appears to give results accurately and quickly with small amounts of material. Seeing that the Sörensen, van Slyke, and Abderhalden methods for determining amino-acids have each in their turn been most fruitful in advancing the knowledge of the proteins much is to be hoped from the application of the new method.

MR. FRANCIS EDWARDS, bookseller, 83 High Street, Marylebone, W., has issued a catalogue of books, pamphlets, engravings, maps, and manuscripts relating to the whole American continent. The catalogue contains some 1662 entries, many of them referring to works of unique interest.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JANUARY, 1914:—

Jan. 3. 9h. 0m. Earth nearest the Sun.
5. 6h. 0m. Mars at opposition to the Sun.
8. 21h. 41m. Saturn in conjunction with the Moon (Saturn 6° 47′ S.).
11. 1h. 49m. Mars in conjunction with the Moon (Mars 0° 34′ S.).
12. 1h. 39m. Neptune in conjunction with the Moon (Neptune 4° 26′ S.).
17. 7h. 0m. Neptune at opposition to the Sun.
20. 4h. 0m. Jupiter in conjunction with the Sun.
24. 21h. 0m. Mercury in superior conjunction with the Sun.
25. 6h. 32m. Venus in conjunction with Jupiter (Venus 0° 33′ S.).
,, 8h. 43m. Jupiter in conjunction with the Moon (Jupiter 3° 22′ N.).
,, 8h. 54m. Venus in conjunction with the Moon (Venus 2° 48′ N.).
27. 20h. 0m Uranus in conjunction with the Sun.
30. 15h. 36m. Venus in conjunction with Uranus (Venus 0° 30′ S.).

A FAINT NEW COMET.—A Kiel telegram dated December 18 reports the discovery by Delavan of a comet of magnitude 11·0 on December 17 at 10h. 34·8m. La Plata mean time. Its position is given as R.A. 3h. 3m. 19·2s., declination 7° 25′ 24″ south.

A further telegram from Kiel, dated December 19, reports the observation of this comet at Bergedorf on December 18, at 8h. 5·3m. Bergedorf mean time. It is stated to be of magnitude 11·0, and its position is given as R.A. 3h. 2m. 41s., and declination 7° 21′ 29″ south.

THE EARTH'S ALBEDO.—*Astronomische Nachrichten*, No. 4696, is occupied for the main part with a contribution by Mr. Frank W. Very on the earth's albedo. The research consists of determining the albedo from visual observations on the earth shine on the moon in comparison with light from similar sun-illuminated areas on the moon's surface. The contribution describes in the first instance the photometer employed, the methods of procedure, and the necessary constants of the instrument. Then follow the records of the observations made during the years 1911 and 1912. Mr. Very finally concludes that in round numbers the earth shine at new moon has an intrinsic brightness of about 1/1600 of moonlight of average quality, such as is received shortly before first quarter. He eventually states, as a final result, that the albedo of the earth may be taken as Ae=0·89. This value he finds favours the higher of the two values of the solar constant, namely 3·6 cal./sq. cm. min., which he published at the beginning of this year.

ANNUAIRE DE L'OBSERVATOIRE ROYAL DE BELGIQUE.—The Royal Belgium Observatory's Annual, published under the direction of M. G. Lécointe, the director of the observatory, is well known to amateur and professional astronomers on this side of the channel, and the issue for the year 1914 will be found as useful as ever. The aim of the publication is to present the indispensable elements to those who interest themselves in astronomical observations and to help render the science more popular by means of numerous clearly written articles on various astronomical topics. The list of the contents is a very full one, but attention can only be directed to one or two of the items inserted. The recent progress of astronomy, *i.e.* the progress up to the end of the year 1911, is well summarised by M. P. Stroobant, and is very well illustrated. Under "Periodic Comets" an interesting table is given showing, among other facts, the epochs of the first and next appearances. The scheme for the distribution of international time by wireless is thoroughly described, and such sections as those devoted to different tables, their cost, elementary notions on the measurement of time, &c., will be found useful.

DISTRIBUTION OF ELEMENTS IN THE SOLAR ATMOSPHERE.—In this column for September 11 very brief reference was made to an important paper by Mr. Charles E. St. John on radial motion in sun-spots, the contribution in question dealing with the distribution of *velocities* in the solar vortex. The November number of *The Astrophysical Journal* (vol. xxxviii., No. 4, p. 341) is devoted to a second portion of the investigation, and deals with the distribution of the *elements* in the solar atmosphere. This paper forms No. 74 of the contributions from the Mount Wilson Solar Observatory. Mr. St. John finds that radial displacements are intimately associated with depth, and, assuming as a standard a series of displacements shown by the iron lines, he deduces the relative level of twenty-six other elements of the reversing layer and chromosphere. The distribution shows that the form of calcium that produces the H and K lines is at the highest level, followed by the Hα line of hydrogen. Then successively come the vapours of magnesium, sodium, iron, aluminium, &c., each increasing in absolute density with the depth until in the lowest portion of the reversing layer occur also the vapour of all the elements the lines of which appear in the solar spectrum. It is interesting to note that enhanced lines show smaller radial displacements than unenhanced lines of the same solar intensities, and thus originate at higher levels in and near sunspots. A differentiation is also made between the levels of different groups of iron lines. A comparison of the radial displacements with the weakening and strengthening of spot lines shows that the latter is associated with increase of depth and the former with high elevations. Numerous other important conclusions are included in this investigation.

SCIENCE IN AGRICULTURE.[1]

IT might truly be said that only within the last two decades has the importance of the scientific investigation of the infinite number of problems arising from agricultural practice received, in some measure, general recognition. During this period it has become more and more evident to those engaged in the production of plant and animal commodities that it is sometimes merely foolish, and at others almost dangerous, from an economic point of view not to accept the help freely proffered by agricultural educational authorities. The aid given by these bodies may be embodied in one or several schemes, such as the institution of demonstration experiments to illustrate certain manurial and cultural measures, the value of which is indisputable, facilities for consultation with experts in cases of special fungoid and insect pests, educational measures by means of in-college lectures and peripatetic work, and, lastly, the creation of a close connection between the farmer and the research worker.

The white woolly currant scale. From "The Journal of the South-Eastern Agricultural College."

The report before us provides an inspiriting example of such agricultural activity and indicates to the general reader how much may be accomplished by efficient organisation and sound work; to the agriculturist of the south-eastern counties it would constitute what might almost be regarded as a book of reference on many matters agricultural.

The work is compiled in the form of reports from the departments of agriculture and dairying, horticulture, economic zoology, chemistry, botany, mycology, veterinary science, and concludes with general notes. Although much of the subject-matter must pass unnoticed here owing to lack of space, reference may be made to experiments on pig-feeding and the winter feeding of dairy cows, the effect of ferrous sulphate on the quality and quantity of potatoes, the valuation of basic slag, and weeds in seed samples, the latter article being illustrated by many admirable plates. Some valuable experiments have been made on celery blight (*Septoria petroseline*, var. Apii) and its prevention, the results obtained showing that a vast improvement may be induced both in size and value of produce by means of spraying with Bordeaux mixture.

In his report, the economic mycologist directs attention to the disquieting fact that the compulsory measures of the "American Gooseberry Mildew Orders," as at present carried out, do not in any way check the spread of the disease to fresh plantations. At the beginning of the season there were in Kent alone about 3300 acres of mildewed plantations, and it is evident that the measures with respect to the autumn pruning of diseased bushes will have to be uniformly enforced in order to keep down further spread and to prevent the measures taken by conscientious growers being largely nullified by laxity in others.

The report on economic zoology maintains its usual high standard and outlines the various insect pests which have come under observation during the year. Of these, a bad attack by the white woolly currant scale (*Pulvinaria vitis v. ribesiae*) is reported, a portion of an affected plant being shown in the accompanying illustration.

A vaccine has been prepared by the veterinary department, and is being used in the "struck sheep" experiments, and we look forward with interest to the publication of the results of this work.

[1] The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 28. Pp. 476. (London and Ashford: Headley Bros., 1912.) Price 7s. 6d.; Residents in Kent and Surrey, 3s. 6d.

THE CHANK BANGLE INDUSTRY IN INDIA.

FROM a commercial as well as an artistic point of view the chank or conch shell industry is so important that in 1910 the Government of Madras deputed Mr. J. Hornell, superintendent of the Pearl and Chank Fisheries' Department, to visit northern India and report upon the subject. The result of his inquiries is described in an interesting monograph published in vol. iii., No. 7, of the Memoirs of the Asiatic Society of Bengal.

He begins by discussing the literary evidence of the position of the industry in early times, and reviews the evidence from the large collection of prehistoric remains collected by Mr. Bruce Foote, now deposited in the Madras Museum. Mr. Foote was inclined to assign many of these chank or conch shell ornaments to the Neolithic period. But this identification is, in many cases, not supported by the investigations of Mr. Hornell, who points out that many of the specimens bear marks of the use of iron saws or other metal implements.

The shells of the sacred Indian chank or conch (*Turbinella pyrum*, Linn.) are principally found in the Gulf of Manaar, whence, to the number of about two millions, they are annually exported to Calcutta. At present the industry of bangle-cutting is confined almost entirely to Bengal, but Mr. Hornell shows that in former times it was widely spread over the greater part of India, relics of bangle-workshops being discovered from Tinnevelly in the extreme south to Kathiawar, and Gujarat in the north-west, through a long chain of factories located in the Deccan. The causes of this transfer of the manufacture are somewhat obscure, but Mr. Hornell largely attributes it to the upheaval resulting from the Mahomedan conquest of southern India.

Mr. Hornell describes the condition of the industry as flourishing. While there is an increasing demand for gold ornaments, the Swadeshi movement in favour of Indian-made goods has greatly stimulated the trade. He gives full details, with photographs, of the methods employed in the manufacture, and his discussion of the religious and social influences which encourage the use of this form of ornament not only in Bengal, but as far north as Tibet, from Ladakh in the west to the Kham country on the east, make this excellent account of a curious industry more than ordinarily instructive.

BOTANY AT THE BRITISH ASSOCIATION.

THE Birmingham meeting of the British Association was, from the point of view of the Botanical Section, as from others, highly successful. There was a very large attendance of botanists, particularly of the younger ones. The meeting of the section this year was noteworthy in being presided over by Miss Ethel Sargant, the first woman president of any section of the association. It is scarcely necessary to state that the section suffered in no way as a result of the innovation. The president's address having been previously reported in full in these columns, it is unnecessary here to attempt to summarise it. It dealt with the progress of vegetable embryology in recent years, the subject being treated from the morphological side. The great difficulty in all such work, as the president herself pointed out, is to distinguish between adaptive characters of comparatively recent origin and the characters inherited from remote ancestors. However, the study has already thrown much light on embryological problems, and is likely to throw more as time goes on.

Fossil Botany.

Dr. D. H. Scott contributed an important paper on some fossil plants from Devonian strata. The specimens described were collected by Prof. C. R. Eastman near Junction City, Boyle County, Kentucky, from the nodule-bearing layer at the base of the Waverley shale, in the lower part of Upper Devonian strata. They are thus (at present), among the oldest known land-plants showing internal structure. The communication was made in the joint names of Prof. E. C. Jeffrey, of Harvard, and Dr. Scott. The following fossil-plants were described:—(1) *Calamopitys americana* (sp. nov.), Jeffrey and Scott. This has mixed pith, containing tracheides, and paired leaf-trace bundles in the wood. (2) *Kalymma* petioles. This no doubt belongs to a species of Calamopitys. (3) *Calamopteris Hippocrepis* (sp. nov.), Jeffrey and Scott. This is a petiole of the Kalymma group, but with the bundles arranged in a horse-shoe form, and largely fused. These three fossils are members of the group Pteridospermeæ. (4) *Archaeopitys Eastmanii* (gen. et sp. nov.), Jeffrey and Scott. This is a stem with dense secondary wood and numerous small mesarch strands of xylem scattered in the pith. It is probably a member of the group Cordaitales. (5) *Periastron perforatum* (sp. nov.), Jeffrey and Scott. This is a curious petiole with a median row of separate vascular bundles and large lacunæ in the ground tissue. It is allied to *P. reticulatum*, Unger; but it is not known whether it is a pteridosperm or a fern. (6) *Stereopteris annularis* (gen. et sp. nov.), Jeffrey and Scott. This is probably a fern, with a petiole possessing a single large vascular bundle, with solid wood, external protoxylem, and cortex differentiated into several distinct zones. (7) *Lepidostrobus devonicus* (sp. nov.), Jeffrey and Scott. This has an axis of an ordinary Lepidostrobus type. The sporangia have the usual columnar wall, and the spores are in tetrads. It is the oldest known fructification with structure of any plant. The most remarkable matter concerning these very ancient land-plants is their high structural organisation.

Mr. H. H. Thomas followed with an account of a new type of Ginkgoalian leaf, found in the Jurassic plant-bed at Cayton Bay, near Scarborough. The leaves are beautifully preserved, linear or oblanceolate in outline, with rounded or slightly bifurcated apices, short petioles, and dichotomising venation. The form of the stomata and subsidiary cells is very like that of other Ginkgoalian leaves, while they possess the secretory tracts between the veins as seen in the modern form. The epidermal cells possess very characteristic papillæ. The leaves form the type of a new genus, Eretmophyllum, with two species, the second one occurring at Whitby. The specimens provide a further illustration of the importance of the Ginkgoales in the Mesozoic vegetation.

Dr. Ethel de Fraine described a new species of Medullosa from the Lower Coal Measures.

Anatomy.

Dr. M. J. le Goc gave an account of the transition of centrifugal xylem to centripetal xylem at the base of the petiole of Cycads. The centrifugal system at the base is in great part a secondary growth, and the centripetal system a primary structure; both are consequently independent morphologically. The two kinds of xylem overlap at their ends, and are connected for a physiological function. Their reduced extremities point to a time when possibly they ran parallel throughout their entire length.

Mr. R. C. Davie spoke on the pinna-trace in the Filicales. The "marginal" type of vascular supply in the Filicales occurs generally in leaf-traces which have no hooks at their ends; the "extramarginal" type appears regularly in connection with leaf-traces possessing incurved hooks. Variations from these types were described.

Histology.

Miss M. Hume gave the results of her researches on the histology of the leptoids in the moss Polytrichum. These leptoids do not deserve the name of sieve-tubes. Their contents differ from those of the other lining cells in never including starch-grains or large drops of oil; but each leptoid has a nucleus. They are rich in connecting protoplasmic threads. The conducting function of the leptoids seems to be confined to albuminous materials, and not to be concerned with carbohydrates.

Physiology.

Last year, at Dundee, Prof. W. B. Bottomley directed attention to the effect of soluble humates on plant growth. This year he further maintained that ammonium humate can supply the nitrogen need of plants if soluble phosphates and potassium salts are present in the culture solution.

Mr. W. N. Jones gave an account of his investigations on anthocyan formation. Coloured petals of stocks, &c., soaked in 95 per cent. alcohol became colourless, but regained their colour when transferred to water. It is believed that a pigment-producing mechanism, and also a reducing body are present in the petals. The amount of water in the cells determines which way the pigment reaction shall go. It also appears that considerable quantities of reserve "raw material" occur in petals from which pigment can be produced. The darkening of many flowers on fading is explicable on the assumption that this raw material comes into action.

Dr. E. M. Delf read a paper on the transpiration of sclerophytes.

The Nature of Life.

Prof. J. Reinke, of Kiel, dealt with the subject of the nature of life. In the period preceding the present the dogma prevailed that the phenomena of life ought to be interpreted merely mechanically. In still older times, people believed a *vis vitalis* to be active in the organism. Now the doctrine has arisen that life is only a complicated example of the processes predominant in lifeless nature; and physiology then becomes the chemistry and physics of organisms. Prof. Reinke, for his part, refused to adopt either the exclusively vital or the exclusively mechanical dogma. Life has its own laws, though this view does not exclude the fact that physico-chemical laws reign in the elementary processes of a living body.

Fungi.

Dr. O. V. Darbishire described the development of the apothecium in the lichen Peltigera. The early stage of the "fruit" is found amongst the young marginal hyphæ. Certain cells arise, which at first are uninuclear, but which become multinuclear. Fusions with neighbouring cells are common; but no transference of nuclei has been observed. No coiled carpogonia can be distinguished. The multinuclear condition seems to be due to simultaneous nuclear divisions in the cells, and not to any passage of nuclei. Long, unbranched, multicellular hyphæ grow towards the cortex, whilst nuclear division is still active. These appear to be functionless trichogynes, and gradually disappear. Certain of the large cells—the "ascogonia"—now grow out, and the nuclei formed by simultaneous division—female nuclei—pass into the ascogenous hyphæ in pairs. From these the asci appear to derive their first nucleus in the usual way.

Mr. S. P. Wiltshire spoke on the biology of the apple-canker fungus (*Nectria ditissima*), a genuine wound parasite. The chief means of inoculation in nature are injuries made by frost and by the woolly aphis (*Schizoneura lanigera*). The relatively immune varieties of apple may be readily infected through suitable injuries.

Miss M. L. Baden described the conditions necessary for the germination of the spores of *Coprinus sterquilinus*. She arrived at the conclusion that in some way bacteria are necessary for the germination of the spores of this fungus; and suggestions were made as to the way the bacteria are of benefit from this point of view.

Miss E. M. Poulton gave an account of the structure and life-history of Verrucaria, an aquatic lichen. She showed how the structure of the thallus changed with advancing age, and how the ascospores underwent simultaneous germination within the perithecium, the tufted mass of mycelium thus produced being expelled into the water, and forming an efficient trap for the capture of the floating green unicellular Algæ.

Prof. A. H. R. Buller, of Winnipeg, read a paper on the organisation of the hymenium in the genus Coprinus.

Algae.

Prof. G. S. West gave an account of the structure, life-history, and systematic position of the genus Microspora. After pointing out that species of this genus were amongst the most abundant and widely distributed of fresh-water Algæ, and that the controversy concerning its systematic position was mainly due to defective knowledge, an account was given of its cytology and reproduction. The zoogonidia invariably possess two cilia, and there appear to be two distinct methods by which they may be liberated, with various intermediate conditions. The aplanospores and akinetes were fully discussed, and the conclusion arrived at that Microspora would be best placed in the family Microsporaceæ of the Ulotrichales.

Prof. G. S. West and Miss C. B. Starkey had a paper on *Zygnema ericetorum* and its position in the Zygnemaceæ. It was shown that published accounts of the cytology of this common Alga are all erroneous; also that its conjugation, as observed in West Indian examples, is quite normal. The genus Zygogonium of Kützing (1843) cannot be accepted as of any value, and the Zygogonium of De Bary (1858) and Wille (1897, 1909), is based upon De Bary's figures of two apparently monstrous conjugating examples.

Dr. E. M. Delf gave an account of an attached Spirogyra.

Ecology.

Prof. F. W. Oliver discoursed on the distribution of *Suaeda fruticosa* and its rôle in the stabilising of active shingle. Shingle beaches exposed to the sea are liable to travel landward during times of high tides when these are accompanied by onshore gales. *S. fruticosa* is the most effective plant in retarding this process, and is the most effective stabiliser of all British shingle plants. Valuable agricultural alluvial pasture is sometimes greatly endangered by the movements of shingle beaches, and the suggestion was made that the "afforestation" of certain shingle beaches by *S. fruticosa* was a matter of practical importance.

Mr. P. H. Allen outlined a botanical survey, which some botanical students at Cambridge have undertaken, of the maritime plant formations at Holme, Norfolk. The area is characterised by (1) a salt marsh, with *Armeria maritima, Statice Limonium, S. binervosum, S. vellidifolium, Cochlearia anglica, Salicornia perennis, S. disarticulata, Atriplex portulacoides*, and other halophytes; (2) a shingle bank, with *Suaeda fruticosa* and *Frankenia laevis*; and (3) sand-dunes, with *Ammophila arenaria, Elymus arenarius*, and *Hippophaë rhamnoides*. The mapping out of the area was begun by chaining out a base line seven furlongs (ca. 1·4 km.) in length. At each furlong offsets were chained out to the cultivated land on the one side and low-water mark on the other. The mapping in of the plants in the smaller areas thus obtained was done with the plane table on a scale of 80 in. to the mile (1 : 792). Work on the analysis of the soil and the soil-water is being carried on. It is hoped that light will be shed on some of the problems of plant-distribution, and that a detailed record of the succession of changes occurring over the area will also be obtained.

Mr. A. R. Horwood presented his ideas with regard to the influence of river-development on plant-distribution.

Miss W. H. Wortham described some features of the sand-dunes in the south-west of Anglesey. The fixed dune association is a *Caricetum arenarieae*, which forms a close sward. The shifting dunes, with *Ammophila arenaria* and *Euphorbia paralias*, alternate with embryonic stages of dune-marsh, with *Salix* *repens*. Dunes of *S. repens* occur, and have a two-fold origin: (1) the inundation of a dune-marsh with sand, and (2) invasion of Salix seedlings. The ultimate association of the marsh of *S. repens* is a *Callunetum vulgaris*, and of the dunes an *Agrostidetum vulgaris*.

Genetics.

Dr. R. R. Gates brought forward some evidence to show that mutation and Mendelian splitting are different processes. He maintained that definite evidence has been obtained to show that some of the mutations in Œnothera are not due to recombinations of Mendelian characters, as some biologists have assumed, but to irregularities in meiosis, which lead to changes in nuclear structure.

In connection with the visit of Sections D, K, and M to the Burbage Experimental Station for Applied Genetics, Major C. C. Hurst read a paper on the inheritance of minute variations in garden races of Antirrhinum. The garden variety, "Aurora," breeds true to its bushy habit of growth, its scarlet lips, and its ivory throat; but individual plants show slight differences in habit, precosity, and in size and colour of flowers. Experiments on these, in conjunction with others on sweet peas and culinary peas, show that many presumed unit-factors can be analysed into several subfactors which themselves behave as units. It is also evident that these minutely continuous variations are strictly discontinuous in their inheritance.

Miscellaneous.

Prof. F. E. Weiss recorded and described a case of juvenile flowering in *Eucalyptus globulus*.

Dr. A. S. Horne described the variations in the flower of *Stellaria graminea*.

The semi-popular lecture was this year delivered by Prof. W. H. Lang. The subject, "Epiphyllous Vegetation," dealt with the different forms of plant-life which pass their lives on the surface of the leaves of tropical plants, and attracted a large and interested audience.

Colonel H. E. Rawson described his experiments and observations on the variation of the structure and colour of flowers under insolation. The paper was a continuation of one communicated to the section in 1908. His method was to shade off with a perfectly opaque screen all direct rays of the sun for certain selected intervals of daylight, while admitting all the diffuse light possible. By this means, it is claimed, many colour and other forms were produced. Colonel Rawson maintained that his experiments, which have now extended over eight years, definitely point to a connection between the variations of colour and structure and the sun's altitude, both seasonal and diurnal; and he suggested that solar rays of different refrangibility are transmitted through the atmosphere at different altitudes.

Preservation of the British Flora.

Mr. A. R. Horwood introduced the subject of the preservation of the British flora, which has come into some prominence again during the past year or two. He pointed out that there are some factors which tend to the extirpation of certain British plants, and are difficult to control except in special ways. He asked for information as to the extent of the effect of these factors, and for suggestions for combating their effects. Factors mentioned were drought, drainage, cultivation, building operations, and the spread of golf courses. He added his opinion that an Act of Parliament was required to deal effectively with some aspects of the general problem. There was some disagreement among the speakers who followed as to the best means of attaining the desired end.

The committee of the section passed a resolution expressing sympathy with the general object, but withholding their support from any proposal which might tend to affect the present law of trespass.

Joint Meetings.

Two meetings were held jointly with other sections. The first was held in conjunction with the newly formed Agricultural Section, when some problems in barley production were discussed. The second was held in conjunction with the Zoological and Physiological Sections, when Prof. B. Moore introduced a discussion on the synthesis of organic matter by inorganic colloids in the presence of sunlight, this subject being considered in relation to the origin of life. Fuller accounts of these joint meetings are given in the reports of these sections.

Exhibits.

A series of exhibits of Algæ and fungi were arranged by Prof. West in the Botanical Laboratory. Among the Algæ were twenty selected Caulerpas, to show how the different species simulate the various types of habit found in higher plants; some beautiful examples of Lithothamnion, Lithophyllum, and other stone Algæ; microscopical preparations of various Algæ, including conjugated Desmids, showing all types of Zygospores, *Euastropsis Richteri*, akinetes of *Microspora floccosa*, the largest known Desmid (*Closterium turgidum* subsp. *giganteum*), *Tetraspora gelatinosa*, showing the pseudocilia, and the following Volvocaceæ—*Platyodorina caudata*, *Pleodorina illinoisensis*, *Pleod. californica*, *Volvox africanus*, and *V. Rousseletii*.

The fungi included numerous Deuteromycetes, Pyrenomycetes, Discomycetes, Uredineæ, Ustilagineæ, and Hymenomycetes, mounted for class purposes; a series of dried specimens of the Polyporeæ; specimens of *Batarrea phalloides*, *Rhoma pigmentivora*; and cultures of *Sigmoideomyces clathroides*, and of a species of Sepidonium.

Living and fixed specimens of the giant sulphur bacterium, *Hillhousia mirabilis*, were also on view, and a series of about fifty species of Mycetozoa (Myxomycetes) from the midland counties.

Excursions, &c.

More or less informal excursions were held, the following places being visited by some members of the section:—(1) Hartlebury Common, a sandy heath with *Calluna vulgaris*, *Ulex Gallii*, *and Drosera rotundifolia* in the bogs. At this late stage of the summer, the spring ephemerals (including some submaritime species) were invisible. (2) Sutton Park, a great stretch of semi-natural vegetation of heaths alternating with oak woods and marshes, the whole on sandy and gravelly soils. The heaths showed wide expanses of *Aira flexuosa*, *Molinia caerulea*, *Ulex Gallii*, *U. europaeus*, *Calluna vulgaris*, and a little *Empetrum nigrum*. The woods were dominated by *Quercus Robur*, associated with *Betula pubescens* and *Ilex aquifolium*. Some societies of the last-named species were unusually fine. (3) Wyre Forest, an extensive natural forest of *Quercus sessiliflora*, associated with *Betula alba*. Locally, *Carex montana* was an abundant member of the ground vegetation of the forest.

The excursion to the Burbage Experimental Station for Applied Genetics, held jointly with the Agricultural and Zoological Sections, is referred to in the report of the latter section in NATURE of November 27 (p. 389).

The sectional dinner was held on the Saturday evening, when nearly eighty members of the section were present.

Reports of Research Committees.

Mr. R. S. Adamson presented a report on the vegetation of Ditcham Park, Hampshire, Miss M. C. Rayner one on the flora of the peat of the Kennet Valley, Mr. H. H. Thomas one on the Jurassic flora of Yorkshire, and Prof. F. E. Weiss on botanical photographs. The last-mentioned report recommends that all prints of ecological interest should be handed to the newly founded Ecological Society, and that all other prints should be housed in the botanical department of the University of Manchester.

C. E. M.

EDUCATION AT THE BRITISH ASSOCIATION.

THE meetings of the section of Educational Science were in many respects the most successful of recent years. Attendance was uniformly good; both papers and discussions reached a high level of interest. The presidential address has already received a great deal of attention, and as copies will probably be still more widely circulated, we may expect it to stimulate a national educational stocktaking such as cannot fail to be fruitful.

Perhaps the most generally attractive morning concerned itself with the modern university. Sir Alfred Hopkinson, who opened the discussion, made a sympathetic reference to the time when Oxford and Cambridge were in effect the sole training ground for clergymen, public officials, members of Parliament, and Cabinet Ministers. The value of this State service could hardly be exaggerated. The modern universities, in receipt of direct grants from central and local exchequers, must also concern themselves with the old ideal of raising up men and women fitted to serve in Church and State, but they must also contribute directly to the intellectual life of the people about them, as centres from which ideals may radiate amongst the general public and as sources of inspiration wherein the merchant and manufacturer may learn to care for things outside their business. He warmly protested against the heresy which regarded the university as existing to give degrees, whimsically suggesting that the latter must have been invented as a substitute for corporal punishment, and he dwelt upon the importance of research and of the communion between students and men who were engaged in advancing knowledge. Finally, he pleaded for freedom. Poverty would be better than wealth from State support if it meant State interference and control, though the right of the State to lay down conditions in respect of grants for special purposes, like the training of teachers, could hardly be questioned.

Sir Philip Magnus dealt with the professional outlook of the university, and in that connection welcomed the tendency to reduce the age of entrance. Dr. Maclean, formerly president of the Iowa State University, spoke eloquently of the work of universities in the United States and of their development since Harvard received its first State grant of 400*l.* a year in 1636. Mr. Mosely pointed to the danger attached to low emoluments. Business offered such attractive prizes to first-rate men that the universities were in danger of having to recruit their staffs from the second best. Dr. Hadow pointed out the variety and contradictory nature of the current views concerning universities and their function. "He who steers simultaneously for Scylla and Charybdis is in danger of missing both." He showed the greatly widened area of service which State and Church now offered, and emphasised the need of special regard to particular districts, though in that connection he reminded his audience of the definition of utilitarianism in education—the application to useful purposes of knowledge that had ceased to grow. Sir James Yoxall doubted whether the path was as open as it should be to youths of ability; and Dr. H. A. L. Fisher reminded the section of the claims of women, especially in those centres where the district was inclined to regard the university purely from the point of view of industry and commerce.

From the point of view of educational science, the most important meetings were held in conjunction with the psychological subsection. Dr. Kimmins made a strong plea for the endowment of research in education, in which he was supported by Prof. Findlay, Dr. C. S. Myers, Prof. Green, and Mr. C. L. Burt. We have learned not to trust the superficially empirical viewpoint in medicine, and why do we cling to it in pedagogy? Nor is the old *a priori* road satisfactory in a study which is concerned with actuality. Experiment and research are essential to progress. The subsequent discussions on the psychology of reading and spelling brought out the need for a combination of the psychological and the pedagogical point of view in researches that concern class-room problems.

Sir William Ramsay and Sir Oliver Lodge spoke in favour of spelling reform. Sir Oliver Lodge thought we should not trouble very much about spelling, and Sir William Ramsay seemed to think in a phonetically written language there is no bad spelling. As to the former view, teachers would reply that they are concerned with people who cannot afford to spell badly. The president of the British Association may misspell words to his heart's content, but humbler people dare not; a spelling reform will not do away with error in spelling, nor will it prevent the necessity of learning to spell. In any case, there will always be a psychology of spelling and a right and wrong way of acquiring orthographic efficiency.

Mrs. Meredith presented an interesting paper on suggestion as an educative instrument. It was a plea for the rational treatment of the young in the interest of later years when the march of events either leads to the challenge of fundamental conceptions and much painful uprooting, or to intolerance born of prejudice derived from the suggestive influences of early life.

Mr. Burt's paper on mental differences in the sexes aroused a good deal of attention. He pointed out the need for, and difficulty of, distinguishing inborn from acquired character. His researches showed that the differences were less (but were by no means eliminated) when children from mixed schools were compared than when children from girls' and boys' schools were examined. Inborn differences seem to be largest in the simplest psychical processes. Emotional differences seem smaller, though of far-reaching consequence; on higher levels differences between boys and girls become progressively smaller.

A discussion on the educational use of museums was attended by representative anthropologists and museum officials. There was general agreement that, whilst much had been done since the subject was discussed at the last Birmingham meeting of the Association, there was room for inquiry and further development in the direction of making museums more effective educational institutions. The discussion was opened by papers from Dr. Clubb, who described the ideal organisation of a museum as he conceived it, and Mr. Horwood, who confined his attention to the needs of the elementary school engaged in fostering the study of nature. Sir Richard Temple urged the importance of good housing and of educational arrangement. Donors, as well as visitors, were attracted in this way. Dr. Hoyle discussed the needs of the student and the layman. The latter needs good labels and effective guidance; the former wants access and privacy. The first duty of the curator was, however, concerned with neither. His primary business was to preserve.

Dr. Browne told what the Classical Association of Ireland were doing to encourage the use of *Realien* in the teaching of Latin and Greek. Dr. Bather would have special provision for children, and suggested the provision of fellowships and research scholarships in connection with museums. Dr. Haddon spoke of the courage needed to refuse irrelevant objects offered by distinguished donors. A clear idea of the object of the museum and unswerving adherence to that function was, in his view, essential to successful educational work.

Mr. Bolton, Dr. Harrison, and Mr. H. R. Rathbone supported a suggestion to form a committee to consider and report upon the whole subject of museum organisation from the viewpoint of their educational functions. Prof. Newberry described the work already done in Liverpool, and suggested that the label should be written first and the illustrative objects gathered about it. The general feeling that museums might be made to render better educational service was a particularly pleasing feature of the debate. A committee with representatives from Sections C, D, H, K, and L was subsequently formed, with the object of reporting to the Manchester meeting in 1915.

On Tuesday morning the section was busied with the subjects of compulsory school registration and manual work in education. Bishop Welldon, Dr. Sophie Bryant, and Mrs. Shaw spoke strongly in favour of State action in the matter. Bishop McIntyre, as representing Catholic feeling, supported the idea, with the proviso that schools were left free to determine the form and spirit of the education they provide. Mr. Ernest Gray thought action would be easier if provision were made for compensation in case a man's livelihood were taken away. Mr. A. Mosely opposed any such idea as compensation in such cases. The State cannot compensate for inefficiency.

The papers on manual work in education were read by Mr. P. B. Ballard, Mr. T. S. Usherwood, and Mr. W. F. Fowler. Mr. Ballard offered interesting evidence of the stimulating effect of handwork in school; Mr. Usherwood and Mr. Fowler, from the secondary school and primary school point of view respectively, argued in favour of freedom and initiative as opposed to series of graduated exercises based upon an adult view of the elementary processes involved in manipulation. A short discussion followed, in which the old battle between freedom and technique was fought, though the feeling of the meeting was clearly in favour of the newer view.

The last meeting of the section was given to a discussion on the subject of the working of the Education Act of 1902. Sir George Fordham opened in an interesting review of the problems which the Act presented to a county area like that of Cambridge, and of the way his authority had met them. Mr. W. A. Brockington joined issue with those who regarded the act as a failure and who called for a reversion to *ad hoc* authorities. The birth of an interest in secondary education was directly due to the Act. At the same time, some amendments in detail were called for, amongst others those sections dealing with differential rating and with foundation managers of non-provided schools. Alderman Pritchett, Mr. Ernest Gray, and others also spoke warmly of the working of the Act and of the importance of coopted membership to education authorities. Mr. Norman Chamberlain took up the cause of the primary school, and expressed his profound dissent from the pessimism of the presidential address. The section closed with a vote of thanks to the president, moved by Sir George Fordham and seconded by Mr. Ernest Gray.

BEIT MEMORIAL FELLOWSHIPS.

A MEETING of the trustees of the Beit Memorial Fellowships for Medical Research was held on December 17. Dr. F. Gowland Hopkins, F.R.S., was appointed a member of the advisory board in succession to Sir William Osler, Bart., F.R.S., resigned. The Francis Galton Eugenics Laboratory was recognised as a place of research. The annual election to Beit Fellowships was made. The following persons were chosen this year, and we give in each case the character of the proposed research and the institution at which the work is to be carried out.

Dr. John O. W. Barratt, study of nature and mode of action of substances contained in or derived from blood plasma and taking part in plasma or serum reactions; also cytological studies—the Lister Institute; Dr. Myer Coplans, study of immunity with special reference to the action of silicates (including the asbestos minerals, slag, wool, and the zoolites) on bacterial and allied substances—Lister Institute; Mr. Egerton C. Grey, bacteriological chemistry, with special reference to the relation between bacterial enzymes and chemical configuration—the Lister Institute; Mr. John R. Marrack, the chemical pathology of arthritic diseases—(1) the estimation of the uric acid in the blood of patients suffering from certain types of arthritic disease; (2) continuation of the work on calcium metabolism and organic acid excretion—Cambridge Research Hospital; Mr. Victor H. K. Moorhouse, the investigation of the metabolism of animals as indexed by the respiratory quotient under various conditions, with special reference to the question of diabetes—the Institute of Physiology, University College, London; Dr. G. E. Nicholls, to continue research on "the investigation of the structure and function of the subcommissural organ and Reissner's fibre," which up to the present time has been principally concerned with the lower vertebrates; the study of the "pineal region of the brain"—the Biological and Physiological Laboratories at King's College, London; Dr. Annie Porter, on the parasitic Entozoa, more especially Protozoa and Helminthes, infecting vertebrates and certain invertebrates—The Quick Laboratory, Medical Schools, Cambridge; the Liverpool School of Tropical Medicine; and, if possible, the King Institute of Preventive Medicine, Madras, or the Wellcome Research Laboratories, Khartum; Mr. J. G. Priestley, investigation into the factors concerned in the regulation of the excretion of urine—Physiological Department, Oxford; Miss J. I. Robertson, the comparative anatomy and physiology of the heart in the first instance; also the study of the vertebrate nervous system—the Victoria Infirmary, Glasgow; Miss M. Stephenson, the metabolism of fats and its relation to that of carbohydrates in the animal body, having special regard to the light afforded by the study of the fat metabolism of diabetic animals—Institute of Physiology, University College, London; Mr. J. G. Thomson, the cultivation of Protozoa (the intention is to obtain knowledge of the toxins elaborated by these and the antibodies formed); the cultivation of tumour tissues—the Lister Institute.

Each fellowship is of the annual value of 250*l*. payable quarterly in advance. The usual tenure is for three years, but the trustees have power in exceptional cases to grant an extension for one year. All correspondence should be addressed to the honorary secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, W.

SCIENTIFIC PAPERS IN THE SMITHSONIAN REPORT FOR 1912.

THE annual report of the Board of Regents of the Smithsonian Institution for the year 1912 has now been issued by the Government Printing Office in Washington. It provides full particulars of the varied activities, the expenditure, and the general condition of the Institution for the year ending June 30, 1912. But, as usual, the most attractive part of the volume, which runs to 780 pages, is the general appendix of 650 pages of contributions by scientific workers of many nationalities. These papers are sometimes translations of important contributions to scientific periodicals in different parts of the world, sometimes lectures or addresses of note, and in other cases original articles.

Among the numerous translations may be mentioned those of Prof. P. Puiseux's article in the *Revue générale des Sciences* of June 30, 1912, on the year's progress in astronomy, and that in the *Revue Scientifique* for April 6, 1912, on spiral nebulæ. Another translation is of an article by Mr. C. V. Boys on experiments with soap bubbles. The original was published in the *Journal de Physique*, August, 1912, and was a lecture delivered before the French Physical Society in April of that year. From the *Revue générale des Sciences*, November 30, 1912, is taken also Prof. Emile Borel's address on molecular theories and mathematics, which was delivered on the occasion of the inauguration of the Rice Institute at Houston, Texas. This is followed by an essay by the late Henri Poincaré on the connection between æther and matter, an address delivered before the French Physical Society on April 11, 1912, and printed in the *Journal de Physique*, May, 1912. It may be remarked here that at the end of the volume there is an interesting biography of Henri Poincaré, his scientific work, and his philosophy, written by Dr. Charles Nordmann. From the *Journal de Physique*, June, 1911, is taken also Sir William Ramsay's address to the French Physical Society on the measurement of infinitesimal quantities of substances, in which he details some of the recent efforts of men of science "to see the invisible, to touch the intangible, and to weigh the imponderable." Prof. L. Lecornu's "Review of Applied Mechanics" is taken from the *Revue générale des Sciences* of July 30, 1912; M. A. Lacroix's essay on "A Trip to Madagascar, the Country of Beryls," is from *La Géographie*, November 15, 1912; and that by M. R. Legendre on the survival of organs and the "culture" of living tissues is from *La Nature*, November 2, 1912, where he cites remarkable experiments the results of which have proved that organs and living tissues may be preserved for some time "in cold storage," and then transplanted or grafted to the living bodies of other individuals of the same species. An essay on adaptation and inheritance in the light of modern experimental investigation, by Herr Paul Kammerer, is from *Himmel und Erde*, June, 1911. Dr. L. Gain's account of the penguins of the Antarctic regions is from *La Nature*, July 6, 1912.

Prof. Zaborowski's paper on ancient Greece and its slave population is translated from the *Revue Anthropologique*. From it one is enabled to obtain a good idea of the social and economic conditions which prevailed in ancient Greece during the height of the slave traffic, which was instrumental in effecting a decline in the efficiency and productiveness of her citizens. Slaves were employed at such low rates and were secured in so many ways, that everyone owned at least one or two, who were made to perform all the household and industrial work, leaving the citizen owners to spend their time in idleness and luxury. The prevailing economic conditions and customs tended to lower the *moral* of families, and reduce their numbers. Enriched by slave labour, and entertained by the doings of men and women purchased from abroad, the Greeks became spectators of life and practically renounced the raising of children.

Among notable addresses included in the appendix Prof. Schäfer's presidential address to the Dundee meeting of the British Association takes a prominent place. Prof. G. Elliot Smith's presidential address to the Anthropological Section at Dundee on the evolution of man appropriately follows Dr. Schäfer's. Dr. Edward Sapir's lecture at the University of Pennsylvania on the history and varieties of human speech is reprinted from the *Popular Science Monthly*, July, 1911. Prof. H. T. Barnes's Royal Institution lecture on icebergs and their location in navigation is given in full.

Many original contributions are also included. Prof. W. J. Humphreys, professor of meteorological physics in the United States Weather Bureau, contributes an article which will be of interest and of practical value to aviators and students of mechanical flight. It is entitled "Holes in the Air," which means the various places in the atmosphere where the conditions, so far as flying is concerned, very much resemble actual vacuities. The author explains the nature of the nine known types of atmospheric conditions, which he groups under two heads: the vertical group and the horizontal group. After carefully covering the dangers resulting from such atmospheric conditions, Prof. Humphreys concludes his article with the following note:—

"All the above sources of danger, whether near the surface, like the breakers, the torrents, and the eddies, or well up, like the billows and the wind sheets, are less and less effective as the speed of the aëroplane is increased. But this does not mean that the swiftest machine necessarily is the safest; there are numerous other factors to be considered, and the problem of minimum danger or maximum safety, if the aëronaut insists, can only be solved by a proper combination of theory and practice, of sound reasoning and intelligent experimentation."

Mr. F. B. Taylor, of the U.S. Geological Survey, contributes an essay on the glacial and post-glacial lakes of the Great Lake Region, and Mr. A. H. Brooks, of the same service, one on applied geology.

Mention must be made of the articles reprinted from English periodicals, among which we notice Prof. Armstrong's "Origin of Life: A Chemist's Fantasy," which appeared in *Science Progress*, October, 1912.

As usual, the illustrations are numerous and excellent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Lord Rayleigh will unveil a tablet to the memory of Lord Lister at King's College, London, on Wednesday, January 14, at 4.30. The ceremony will be followed by the inaugural lecture of the newly appointed professor of physics, Prof. O. W. Richardson, F.R.S., who will take as his subject, "The Discharge of Electricity from Hot Bodies."

Dr. George Senter, reader in chemistry in the University of London, and lecturer in chemistry at St. Mary's Medical School, has been appointed to the position of head of the department of chemistry at Birkbeck College, in succession to Dr. Alexander McKenzie, who was appointed recently to the chair of chemistry at University College, Dundee (University of St. Andrews).

A FUND of 100,000*l*., which the Knights of Columbus of the United States have been collecting for more than two years for the Catholic University at Washington, has been completed. The gift, says *Science*, will be presented to the institution some time during the Christmas holidays. From the same source we learn that the board of regents of the University of California has announced the completion of the additional fund of 120,000*l*. for the erection of the hospital building which is to be a part of the college of medicine of the University.

THE late Right Hon. G. W. Palmer bequeathed 10,000l. to University College, Reading. We learn from the *Reading University College Review* for December that Mr. Alfred Palmer has suggested that this legacy should be devoted to building a university library, and on behalf of Mrs. G. W. Palmer, his sisters, and himself, has offered to supplement it to such extent as will be necessary to enable a suitable library to be built on the site reserved for the purpose, and also to provide an endowment fund for maintenance. The library would thus become a memorial to Mr. G. W. Palmer. The council of the college has approved the proposal gratefully.

THE Eugenics Education Society is organising a course of instruction on the groundwork of eugenics which will be given during the spring and summer of 1914. Dr. L. Doncaster will deliver eight lectures on evolution and heredity at the Imperial College of Science, South Kensington, on Fridays, at 5.30 p.m., beginning January 23, and Dr. M. Greenwood, Jun., will give instruction in statistical methods as applied to problems in eugenics, at the Lister Institute, Chelsea Bridge Road, S.W., on Fridays at 5.30 p.m., beginning May 1. Dr. Doncaster will discuss the general evidence for evolution and the more important theories of evolution, variation, and mutation, theories of heredity, old and new, the relation between heredity and sex, and the facts of heredity in man, together with the bearing of all these things on human improvement. Dr. Greenwood will give an outline of statistical work and theories bearing on heredity, and will explain the principal statistical constants, such as means, standard deviations, and coefficients of correlation. Their calculation will be illustrated on suitable data. The fee for the combined courses will be one guinea, to be paid in advance to the hon. secretary, Eugenics Education Society, Kingsway House, Kingsway, W.C., to whom all inquiries should be addressed.

THE report of the work of the department of technology of the City and Guilds of London Institute for the session 1912–13 has now been published by Mr. John Murray. At the recent examinations 21,878 candidates were presented in technology from 448 centres in the United Kingdom, and of these 13,618 passed. By including 812 candidates from India, from the overseas Dominions, and from other parts of the British Empire, and all candidates for special examinations, the total number examined was 25,339. During the session ninety-one centres were visited by the institute's inspectors, several centres receiving two or three visits in order to complete the inspection. It is satisfactory to find the report stating that there can be no doubt that the teaching of technology has greatly improved during the past few years; but it is noted that the examiners have still to direct attention to the insufficient knowledge that some candidates possess of the principles of their subjects, and to the lack of practical knowledge shown by others. The inability of candidates to express themselves clearly is, the report says, perhaps not so noticeable as in past years, but in no fewer than ten subjects the examiners have to direct attention to the difficulty that simple arithmetical calculations present to many candidates—a defect which can only be attributed to insufficient preliminary training.

THE December number of *The Popular Science Monthly* contains an article on the place of study in the college curriculum, by Dr. P. H. Churchman, of Clark University. In it he points out that a renaissance of the old belief in the value of strenuous intellectual work for the young man of eighteen to twenty-two seems to be coming, and that the older universities of the United States are beginning to weed out the incompetents who for several generations have used them as social clubs. For a time this step will mean a decrease in numbers, and to those who only look at the surface of things numbers mean success. The idea that it is not necessary to insist that all those in residence at a college should be real students is called "Oxonian" by the author, and he admits that it has the advantage over the Continental idea of much learning and nothing else. He values highly all those college institutions of a non-intellectual type which contribute to the production of the "college-bred man," but he points out that the college loafer who is up for social reasons avoids strenuous effort even of the non-intellectual kind. He has no confidence in the annual or semi-annual college examinations as a means of discrimination between the idler and the earnest student, and reminds his readers of well-known candidates at Princeton who, after idling away the session, obtained respectively a first class in psychology after two hours' grind at some printed notes and a second class in zoology after five hours' coaching. No examination of the usual type has ever been invented which cannot be circumvented by the aid of an intelligent crammer. He advocates the less formal monthly examination or the better plan of imposing examination tests at any moment without warning and frequently. Such examinations afford the best test of that gradual growth of intellectual power which comes from steady and sustained effort over a long period, and from intercourse and discussion with superiors and colleagues developing along the same or similar lines.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 11.—Sir William Crookes, O.M., president, in the chair.—A. **Mallock**: Intermittent vision. When a wheel turns so rapidly that the separate spokes cannot be seen or easily followed by the eye, and if at the same time the observer receives a small mechanical shock of almost any kind, the spokes appear almost stationary for a fraction of a second. The appearances depend on the speed of rotation, on the brightness of the illumination, and, to a lesser degree, on the nature of the shock. Suitable shocks are given by the contact of the feet with the ground, as in walking, by tapping the head or body, and in many other ways. Experiments are described bearing on the relation between the appearances and the speed of rotation, and an explanation is suggested depending on an assumed variation of sensibility produced by a slight shock. This variation, which it appears is rapidly extinguished, has a periodic time of about 1/18 second, but this differs slightly for different individuals.—Prof. R. J. **Strutt**: Attempts to observe the production of neon or helium by electric discharge. The present experiments were begun in the hope of confirming the work of Collie and Patterson (Trans. Chem. Soc., 1913, vol. ciii., p. 419, and Proc. Chem. Soc., 1913, vol. xxix., p. 217). The results have been negative, whether from a failure to appreciate the proper conditions for the production of neon by electric discharge through hydrogen or from some other cause.—Walter **Wahl**: The relations between the crystal-symmetry of the simpler organic compounds and their molecular constitution. Part iii. —Prof. G. G. **Henderson** and I. M. **Heilbron**: The selective absorption of ketones. The authors have found that the selective absorption of a large number of simple ketones is of the same type, since the absorption bands of all are practically identical. They suggest that the absorption of these compounds may be due to electronic disturbances accompanying oscillations which arise from the alternate formation and breaking down of unstable ring systems within the molecule. F. E. **Smith**: Absolute measurements of a resistance by a method based on that of Lorenz. The instrument employed differs from all other forms of apparatus based on the method of Lorenz, inasmuch as two discs are employed instead of one. The disturbing effect of the earth's magnetic field is thus practically eliminated. The result of the experiments is that a resistance of one international ohm is equal to $1{\cdot}00052 \pm 0{\cdot}00004$ ohms (10^9cm./sec.).—A. N. **Shaw**: A determination of the electromotive force of the Weston normal cell in semi-absolute volts. With a preface by Prof. H. L. **Callendar**. This paper represents the completion of work commenced by Prof. H. L. Callendar and Mr. R. O. King in the years 1894 to 1898. The final result for the E.M.F. of the Weston cell in semi-absolute volts comes out 1·01827 at 20° C., which agrees closely with the mean of the best recent determinations, namely 1·01824.—F. E. **Rowett**: Elastic hysteresis in steel. A thin-walled steel tube was coupled to a coaxial tube of greater section and length. The compound tube was twisted, and the twist in each component measured by spirit levels. The twist of the large tube, in which the stress and therefore also the hysteresis was small, measured the torque applied to the small tube. The elastic hysteresis in hard-drawn tubes was about one-eighth of that in the same tube after annealing.—F. W. **Aston**: A simple form of micro-balance for determining the densities of small quantities of gases. (1) A simple micro-balance is described, by which the densities of gases may be determined relative to some standard gas, using a null method; (2) about half a cubic centimetre only of the gas is required; (3) the determination can be performed in a few minutes, with an accuracy of 0·1 per cent; (4) possibilities of its use in other fields of research are indicated.—T. R. **Merton**: A second spectrum of neon. The spectrum of neon has been investigated under different conditions of electrical excitation. It has been found that with a condensed discharge a second spectrum is developed, as in the case of argon, krypton, and xenon. The strongest lines of the ordinary spectrum are also feebly visible when a condensed discharge is used.

Dublin.

Royal Dublin Society, November 25.—Prof. James Wilson in the chair.—Prof. T. **Johnson**: *Ginkgophyllum kiltorkense*, sp. nov. The author described a stalked leaf of a Ginkgophyllum from the Yellow Sandstone beds of Kiltorcan, county Kilkenny. The bilobed leaf is 5×7 cm., and shows forking venation clearly in its dichotomising segments. It suggests comparison and affinity with *G. Grasseti*, Saporta, from the Permian of Lodève. The specimen indicates that the Ginkgoaceæ occurred in the Devonian epoch. Impressions of the stem, showing distant leaf-scars arranged spirally, and intervening Lyginodendron-like cortical fibres, were also described, as well as certain seed-like impressions.—W. R. G. **Atkins**: Oxydases and their inhibitors in plant tissues. Part ii., The leaves and flowers of Iris. These gave the indirect oxydase reaction throughout, though not in many instances until after the removal of inhibitors by hydrogen cyanide. Prolonged darkness has no decided effect upon the distribution of enzyme or inhibitor. The occurrence of the natural sap pigments in the flowers of about thirty varieties of Iris has been correlated with the presence of oxydase and inhibitor.

Paris.

Academy of Sciences, December 8.—M. F. Guyon in the chair.—H. **Deslandres** and V. **Burson**: The action of the magnetic field on the lines of the arithmetical series in a band of lighting gas. Variation of the number of the lines with the intensity of the field. A study of the violet band λ 3889 in the spectrum of coal gas. The lines of a given arithmetical series are all either divided or displaced in the same manner, the magnitude only of the divisions or displacements being variable from one line to another.—G. **Gouy**: The absence of sensible refraction in the sun's atmosphere. A discussion of the possible effects of abnormal dispersion in lines of emission or absorption from the sun, with especial reference to the views of W. H. Julius.—Ph. **Barbier** and R. **Locquin**; The transformation of citronellol into rhodinol. It is shown that pure rhodinol, the main constituent of essence of roses, can be obtained from citronellol.—M. **Duhem** was elected a non-resident member.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1913. The results are given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Maurice **Gevrey**: Indefinitely derivable functions of given class and their rôle in the theory of partial equations.—G. **Bouligand**: The problem of Dirichlet in an indefinite cylinder.—MM. **Maurian** and de **Moismont**: Comparative measurements of the friction of air on surfaces of different natures. —P. **Idrac**: Observations on the flight of gulls behind ships. In the hovering flight of birds in the neighbourhood of moving ships, the birds are sustained by ascending air currents due to the motion of the vessel. —Victor **Valcovici**: The hydrodynamical resistance of an obstacle in a movement with surfaces of slipping. —A. **Bilimovitch**: Special canonical transformations.—Marcel **Brillouin**: The propagation of sound in a non-absorbent heterogeneous fluid.—Edouard **Guillaume**: The velocity of light and Carnot's principle.—P. **Vaillant**: The polarisation capacity of an electrode submitted to an alternating electromotive force and a method for its determination. The polarisation capacity appears to start from a very high value for zero polarisation, decreases rapidly to a minimum, and again increases continuously. Its order of magnitude is 10 microfarads per sq. mm. for a difference of potential of 0·5 volt between the electrode and the electrolyte.—Marius **Hartog** and Philip E. **Belas**: The trajectory of a permeable particle moving without inertia in a bipolar Newtonian field of force.—G. **Foex**: Molecular fields in crystals and energy at the absolute zero.—E. **Tassilly**: Determination of the velocity of formation of the diazo-compounds. Since a colouring matter was the product of the reaction studied, the reaction velocity was followed with the Féry spectrophotometer. The reaction is shown to be bimolecular.—René **Dubrisay**: The neutralisation of periodic acid. Periodic acid in solution behaves as a tribasic acid.—J. **Barlot** and Ed. **Chauvenet**: The action of carbonyl chloride upon phosphates and the natural silicates.—P. **Brenans**: The nitration of paraiodoacetanilide.—L. **Moreau** and E. **Vinet**: Remarks on the use of wine traps for capturing the moths of Cochylis. These traps, although useful as supplementary means of destruction, cannot be relied upon as the sole protection against Cochylis.—Mme. Marie **Phisalix**: The independence of the toxic and vaccine properties in the cutaneous mucous secretion of Batrachians and some fishes.—L. **Lapicque** and R. **Legendre**: Relation between the diameter of nerve fibres and their functional rapidity.—Jacques **Pellegrin**: The presence of deep-sea fishes on the Paris market. Owing to the increasing depths, up to 200 metres, at which trawling operations are now carried out, numerous specimens of fish considered as very rare are occasionally sold for food in the Paris markets. A list of the rarer forms is given, including *Pterycombus brama*, an archaic fish not represented in the Paris Museum.—J. **Athanasiu** and J. **Dragoiu**: The aërial capillaries of the muscular fibres in insects.—H. **Dominici** and M. **Ostrovsky**: The action of the diffusible poisons of the Koch bacillus upon normal tissues. The results of these experiments invalidate the commonly accepted theory with regard to the pathogeny of the lesions caused by the Koch bacillus.—M. **Javillier** and Mme. H. **Tchernoroutsky**: The comparative influence of zinc, cadmium, and glucinum on the growth of some Hypomycetes. Three moulds were examined —*Poecilomyces varioti*, *Penicillium caseicolum*, and *Penicillium glaucum*—and in each case there was marked catalytic action of zinc salts in stimulating growth. Cadmium showed a similar but much smaller activity, whilst glucinum salts are inert.—Ph. **Glangeaud**: The dislocations and the amethyst-quartz lodes of Livradois. The old extension of the coal basin of Brassac.—G. **Vasseur**: New palæontological discoveries in the upper Aquitanian in the neighbourhood of Laugnac (Lot-et-Garonne). This region is remarkably rich in fossil vertebrates.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint Genis Laval) during the third quarter of 1913.

BOOKS RECEIVED.

Die Vitamine: ihre Bedeutung für die Physiologie und Pathologie. By C. Funk. Pp. viii+193+ii. plates. (Wiesbaden: J. F. Bergmann.) 8.60 marks.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. (New Series.) No. 60. Studies on the Mouth Parts and Sucking Apparatus of the Blood Sucking Diptera. No. 4. The Comparative Anatomy of the Proboscis in the Blood-Sucking Muscidæ. By Capt. F. W. Cragg. Pp. 56+v plates. (Calcutta: Superintendent Government Printing, India.) 1*s*. 9*d*.

Recueil de l'Institut Botanique Léo Errera. By J. Massart. Tome ix. Pp. viii + 408 + iv plates. (Bruxelles: H. Lamertin.)

The Freedom of the Press in Egypt. By K. Mikhail. Pp. xii+37. (London: Smith, Elder and Co.) 1*s*. net.

The Purpose of Education. By St. G. Lane Fox Pit. Pp. ix+83. (Cambridge University Press.) 2*s*. 6*d*. net.

Genera of British Plants. By H. G. Carter. Pp. xviii+121. (Cambridge University Press.) 4*s*. net.

A Practical Manual of Autogenous Welding (Oxy-Acetylene). With a Chapter on the Cutting of Metals with the Blowpipe. By R. Granjon and P. Rosemberg. Translated by D. Richardson. Pp. xxii+234. (London: C. Griffin and Co., Ltd.) 5*s*. net.

Elementary Graphic Statics. By J. T. Wright. Pp. xii+227. (London: Whittaker and Co.) 4*s*. net.

Artificial Parthenogenesis and Fertilisation. By J. Loeb. Originally translated from the German by W. O. R. King. Supplemented and revised by the author. Pp. x+312. (Chicago: University of Chicago Press; London: Cambridge University Press.) 10*s*. net.

Proceedings of the London Mathematical Society. Second Series. Vol. xii. Pp. lix+488. (London: F. Hodgson.)

Elementary Practical Chemistry. Part i., General Chemistry. By Prof. F. Clowes and J. B. Coleman. Sixth edition. Pp. xvi+241. (London: J. and A. Churchill.) 3*s*. 6*d*. net.

The Foundations of Science. By H. Poincaré. Translated by G. B. Halsted. Pp. xi+553. (New York and Garrison, N.Y.: The Science Press.)

Social Insurance, with Special Reference to American Conditions. By I. M. Rubinow. Pp. vii+525. (New York: H. Holt and Co.) 3 dollars net.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 39 Lief. (Jena: G. Fischer.) 5 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt. Lief. 69 and 70. (Jena: G. Fischer.) 2.50 marks each Lief.

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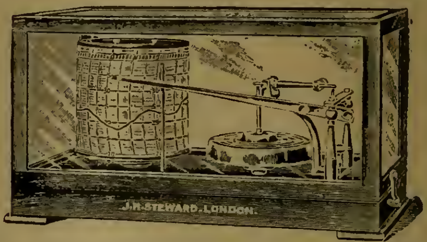

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*" To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2305, Vol. 92] THURSDAY, JANUARY 1, 1914 [Price Sixpence

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THURSDAY, JANUARY 1, 1914.

EVOLUTION AND GENETICS.

Problems of Genetics. By William Bateson, F.R.S. Pp. ix+258. (London: Oxford University Press; New Haven: Yale University Press, 1913.) Price 17*s.* net.

IN 1901 there came into the possession of Yale University the sum of 85,000 dollars with which to establish an annual course of lectures "designed to illustrate the presence and providence, the wisdom and goodness of God, as manifested in the natural and moral world." The endowment is not incomparable in scope and purpose with the well-known Gifford Trust at the Scottish Universities, but it is perhaps characteristic of a younger nation to prefer the natural world to the moral, and rather to seek for wisdom in the facts of nature themselves than in the philosophic wrappings spun around them by the learned through the ages. Certainly it would appear logical that any appraisement of the Almighty's influence in the natural world should be preceded by some knowledge of nature itself.

The task which Mr. Bateson, as Silliman lecturer, set before himself was a discussion of some of the wider problems of biology in the light of knowledge acquired by Mendelian methods of analysis, and the reader who would get most from the book should have some acquaintance with the phenomena of heredity recently brought to light by the method of experiment. To one with even an elementary knowledge of these phenomena, Mr. Bateson's book cannot fail to prove of absorbing interest. For he has the rare gift of infusing something of strangeness into the commonplace, and in his hands the seemingly familiar takes on an aspect of remoteness which once again provokes curiosity.

Nearly twenty years ago the author laid stress on the distinction between meristic and substantive variation, and to-day he is able to emphasise that distinction. The one is connected with the mechanical side of genetics, with the manner in which material is divided and distributed; while the other deals with the chemical side, with the constitution of the materials themselves. To the mechanical problems of genetics, the problems involved in cell division and in the repetition of parts, two of the earlier chapters in the book are devoted. As the result of an interesting discussion Mr. Bateson formulates the rule that germ cells differ from somatic cells in that their differentiations are outside the geometrical order which governs the differentiation of the somatic cells. With the germ cell begins a new geometrical order—a new individual. As to the process which led to the new order—why the cell divides, and why parts become repeated—we are as much in the dark as ever. Mr. Bateson suggests interesting analogies, such as a series of wind-made ripple marks on sand. Yet what is the wind, the meristic force that acts on cell and tissue? The answer is at present beyond us, but Mr. Bateson is not without hope that when the more highly analytical mind of the trained physicist is brought to bear upon the problem, a solution will ultimately be found. At any rate he is not disposed to follow Driesch in declaring that the expression of the living machine in terms of natural knowledge is a hopeless undertaking.

The greater part of the book is concerned with substantive variation, and it is pointed out that through recent work, genetical and chemical, a start has been made towards a real classification of these phenomena. The structural and colour varieties of the sweet pea, the primula, or the mouse can be related to the wild form in terms of their factorial composition. On an evolutionary interpretation it must be supposed that the new form has arisen by the loss of a factor, or, much more rarely, by the addition of one. Can we suppose that species are related to one another in a similar way? Owing to sterility, experimental evidence is generally difficult to obtain, but there are strong indications that some interspecific crosses will eventually find a simple interpretation in terms of Mendelian factors. To what extent such an interpretation may be widely applied, Mr. Bateson is uncertain, but so far he does not see any fatal objection. Even in the well-known case of the Œnotheras, which comes in for lengthy discussion, an explanation in terms of factors is not yet precluded.

Three chapters are devoted to variation and locality, and several interesting cases are brought forward which will probably be unfamiliar to many readers of the book. The main drift of these chapters is the difficulty of accounting for such cases through the agency of natural selection. "Had the phenomena of local variation been studied in detail before Darwin wrote, the attempt to make selection responsible for fixity wherever found could never have been made."

Perhaps the part of the book which will be read with most interest by zoologists is that devoted to the effects of changed conditions. Considerable stir in the biological world has been created recently by experiments which appear to demonstrate the transmission of an effect produced in an organism by a specific alteration of the conditions under which it normally lives. The best known instances are probably Tower's experiments with the potato-beetle and Kammerer's with various amphibia Mr. Bateson has rendered valuable service by subjecting the accounts of these and other experiments to critical examination, and he argues strongly against accepting any case of the kind yet brought forward on the evidence at present available

Taken altogether, this is the freshest and most original book on the problem of species that has appeared for many a year. Whether the reader sees eye to eye with Mr. Bateson or not, there can be no question about its stimulative value. Even if we are further off from the goal than most biologists suppose, there is the consolation that the road to it is more than ever a road of adventure.

TYPICAL GEOGRAPHY BOOKS.

(1) *A Text-book of Geography.* By A. W. Andrews. Pp. xii+655. (London: Edward Arnold, 1913.) Price 5*s*.

(2) *The Upper Thames Country and the Severn-Avon Plain.* By N. E. MacMunn. Pp. 124. (Oxford: Clarendon Press, 1913.) Price 1*s*. 8*d*.

(3) *A Leisurely Tour in England.* By J. J. Hissey. Pp. xviii+400+plates. (London: Macmillan and Co., Ltd., 1913.) Price 10*s*. net.

(1) MR. ANDREWS'S text-book is particularly important from three points of view. He has paid special attention to climate, to maps, and to typical physical conditions. In reference to climate he makes great use of theoretical sun-force, based upon the mid-day altitude of the sun, of actual isotherms, and of the periods in months when temperatures lie between certain limits, *e.g.* 50°–68° F. From the data which he supplies, the student who works through the exercises provided will have a definite and precise knowledge of the climatic facts of the world, arranged in a systematic way. The presentation is novel, but none the less valuable. The numerous maps are appropriate and useful, and the author emphasises the point that most maps used by students are better called diagrams than maps. It is unfortunate that the methods of shading employed for some of these maps makes it difficult to follow the details closely; and even broad points of resemblance and contrast do not show with sufficient clearness; the maps which appear towards the end of the book are a distinct improvement in this respect.

Countries are described in turn; for example, Russia in Europe is considered in five pages of text; climate, products, and trade are briefly summarised, and the main description is given under the heads of the separate river basins and their drainage regions. This illustration will suffice to show the main emphasis of the book, and to indicate that the outlook is physical, not human, physiographic, not economic. This is distinctly a book for the teacher's book shelves.

(2) Miss MacMunn's brief study is an excellent example of work on a definite region. Simply written, it provides sufficient evidence of a geographical kind to interest readers of all ages, and the general treatment is so suggestive that older students should be able to obtain an accurate knowledge of the district studied, not only from the text, but from the numerous maps, which are clear and precise in their presentation of the facts which they are intended to indicate. It seems rather a pity that opportunity was not taken to indicate on some of the maps the location and range of view of the camera for some of the more important photographic illustrations. The fact that many readers will find it necessary to consult Ordnance Survey maps of the district is not in itself a blemish, for the older student who can use such maps will find that Miss MacMunn's book suggests ideas which may be profitably followed out in connection with the multifarious detail which these maps contain.

(3) Mr. Hissey's book is a delightful record of a leisurely tour in search of the picturesque. He reaped the reward of loitering by the way, and found the unfamiliar in a familiar land in a pilgrimage by means of a trustworthy little motor-car through parts of rural England, than which he can imagine no more delightful touring ground. So the author speaks of his book in the preface, and his work breathes the calm and peaceful delight which he took in the pastoral scenery, the quiet homesteads, the peaceful villages. The charm of the book is increased by the numerous appropriate illustrations. B. C. W.

ORGANIC CHEMISTRY, AND ONE OF ITS APPLICATIONS.

(1) *Organic Chemistry for Advanced Students.* By Prof. J. B. Cohen, F.R.S. Vol. ii. Pp. vii+427. (London: Edward Arnold, 1913.) Price 16*s*. net.

(2) *The Volatile Oils.* By E. Gildemeister and Fr. Hoffmann. Second edition by E. Gildemeister. Authorised translation by Edward Kremers. Vol i. Pp. xiii+677. (London, Bombay, and Calcutta: Longmans, Green and Co., 1913.) Price 20*s*. net.

(1) IN the present writer's student days the favourite text-book of advanced organic chemistry was Prof. von Richter's well-known work, which had just been translated into English. Roughly, one might express the difference between that work and Prof.

Cohen's by saying that whilst the former was largely an accumulation of facts, the latter is chiefly an exposition of theories and principles. There is much less recital and much more discussion. The mechanism of the chemical reaction, rather than the properties of the product, is now insisted on; and rightly so, for this aspect of the matter is the more philosophically interesting and scientifically valuable.

In the first chapter, dealing with the valency of carbon, we come at once into a region where speculation and discussion are rife. The author explains the chief theories which have been propounded to account for the existence of bivalent and tervalent carbon, unsaturated groups, labile forms, and so on. He then passes to the consideration of the nature of organic reactions, including such processes as the addition of elements or groups to unsaturated compounds, autoxidation, catalytic reduction and oxidation, condensation, and the formation of chains and rings. The portions dealing respectively with Thiele's theory of partial valencies and with condensation processes will be found especially useful. Indeed, these first two chapters of the work, with their references, might well have served as the basis for the address of the president of Section B at the recent meeting of the British Association.

In chapter iii. we have an exposition of the dynamics of organic reactions. It is satisfactory to note that many of the examples are drawn from the Transactions of the Chemical Society of London—as indeed is the case throughout the book.

Molecular volume, refractivity, dispersivity, magnetic rotation, thermochemistry, and absorption-spectra are next dealt with, and the results applied to problems of molecular architecture. An interesting discussion of the relations between colour and structure follows, and the book ends with an account of the photochemistry of organic compounds.

Occasionally it is not too clear which of two or more theories the author adopts, or favours; but a student who masters the substance of this and the companion volume will be justified in considering himself well grounded.

(2) The first edition of this work has been favourably known for several years to chemists and others concerned with essential oils. To use the translator's phrase, it was "a happy blending of history with chemical science and technology"; and this characteristic is maintained in the new edition. Two volumes, however, are now required, the one under review containing (*inter alia*) the historical matter. This has received additions here and there, but remains substantially as when first published. The authors outline the development of the trade in spices and aromatics during the Middle Ages, and trace the general history of the volatile oils—the essential principles of most spices and aromatic plants—from early Egyptian times onwards. Following this are sections giving the history of the individual volatile oils and of distillation processes. The whole forms an interesting and valuable monograph, enriched with numerous references and quotations; the sketches of ancient distilling apparatus and the photographs of their modern successors are worthy of note for the contrast they offer.

Distillation is a subject closely connected with that of volatile oils, since these are usually obtained by distilling the oil-bearing plants with steam. Not always, however; in certain cases heat destroys the delicacy of the perfume, or the oil does not separate from the condensed water. In such instances the oil is either extracted direct from the flowers with a volatile solvent such as petroleum ether, or absorbed by a suitable fat (*enfleurage*: maceration). These processes are described by the authors in the next chapter, after which the general chemical constituents of the oils are dealt with. The chapter describing these is the longest and most important in the book. All necessary information appears to be given, including numerous structural formulæ, and lists of the plants in which each constituent has been found.

Finally, there is an account of the general physical and chemical methods used in the assay of volatile oils, with notes on adulterants, and two useful analytical tables. The characters of the individual oils are not dealt with in the present volume, but the new edition of "Gildemeister" promises to be the best work on volatile oils which has yet appeared in English. C. S.

OUR BOOKSHELF.

Early Wars of Wessex: Being Studies from England's School of Arms in the West. By A. F. Major. Edited by the late Chas. W. Whistler. Pp. xvi+238. (Cambridge: University Press, 1913.) Price 10s. 6d. net.

"Wessex had to face a determined enemy, which was the most important factor in her steady rise to power" (p. 87). "The western Wessex frontier was for two centuries practically the school of arms for England" (p. 91). After the wedge of Anglo-Saxon conquest was driven to the Severn by the battle of Deorham in 577, separating the Welsh of the Cornish peninsula from their kindred, the Welsh kingdom of Dyvnaint (Dumnonia) kept its independence for two centuries. The Cornish kingdom held out for another century. It was the Welsh that kept this famous "school of arms" going, and it took Wessex some 350 years altogether to learn its lessons (p. 83).

Such, in brief, is the "burden" of this erudite but eminently readable book. It is a fine text-book of open-air history, an attempt to write history "writ large on the face of the country" (p. vii). The available documents are read and expounded *in situ*, so to speak. Archæology, traditions, and folklore "assign their true value to records which have hitherto been loosely read" (p. viii). Accounts of the Scandinavian invasions of western England are read, very properly, in the light of northern antiquities. The first Danish invaders allied themselves with the "bottled-up" "One and Alls," and we learn much about peaceful Danish settlements on the coasts of the Severn. Two archæological maps, many plans and diagrams of camps, and a copious index mark the thoroughness and finish which characterise the whole work. JOHN GRIFFITH.

The British Journal Photographic Almanac, 1914. Edited by G. E. Brown. Pp. 1496. (London: Henry Greenwood and Co.) Price 1s. net.

To photographers the approaching end of the year and the beginning of a new one is always heralded by the announcement of the publication of this almost indispensable year-book, which is so familiar to them and a natural fixture in their studios. The copious material contained between the two covers and the useful facts embodied in it has made it a book of reference difficult to part with. The issue for this year follows mainly the lines of its predecessors, but new features of course have been inserted. These, to state them briefly, comprise a glossary of photographic terms, which, no doubt, will be helpful to many a beginner in the subject of photography.

Lists are given of the German, French, and Italian equivalents for the chief appliances and operations, and these should be most serviceable to those who study foreign photographic journals and books, but have no technical dictionary at their elbow. The beginner is also favourably treated with an excellent series of reproductions of negatives incorrectly exposed and developed, which should show him more than words can express what he must avoid; the accompanying text will also prove of service. The epitome of progress, novelties in apparatus, formulæ for the principal photographic processes, miscellaneous information, tables, &c., are as full and complete as ever, and the great number of advertisements are a valuable feature of the volume.

Hazell's Annual for 1914. Edited by T. A. Ingram. Pp. cxiii + 592. (London: Hazell, Watson and Viney, Ltd., 1914.) Price 3s. 6d. net.

IN addition to its revision up to November 25 last, this twenty-ninth issue of "Hazell's Annual" contains a section entitled "Occurrences during Printing." It justifies its claim to give the most recent information on the topics of the day. A section running to some forty pages is headed "The March of Science," and provides a summary of progress made in the world of science during 1913. An index containing 10,000 references makes it easy for the reader to find his way about the volume.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Pressure of Radiation.

WITH reference to my letter on this subject in NATURE of December 18, the majority of my correspondents complain that, although I may have indicated the possibility of my own view, I have not shown why the simpler relation, that the pressure is always one-third of the energy density, is untenable. As I cannot reply to each individually, I shall be glad if you will allow me space to rectify this omission.

It is generally admitted that the total heat required for the emission (or evolved in the absorption) of unit volume of radiation is the sum of the intrinsic energy density, E/v, and the external work p. By Carnot's principle, this must be equal to $T(dp/dT)$. Whence, if $E/v=3p$, we obtain immediately the fourth power law for full radiation in the usual manner. It would appear, however, by similar reasoning, if E/v is equal to $3p$ for each separate frequency, that radiation of constant frequency should also increase with temperature according to the fourth power law, which is certainly not the case. Either Carnot's principle does not apply, or E/v is not equal to $3p$ for each separate frequency. I have chosen the latter alternative.

It has been shown by Lord Rayleigh, Lorentz, Larmor, Jeans, and others that the electromagnetic equations (from which $E/v=3p$ was first deduced) lead inexorably to Rayleigh's formula,

$$E_\lambda = 8\pi R\lambda^{-4}T/N,$$

without the exponential term, for the partition of energy in full radiation per unit range of wave-length λ. This result appears to be true in the limit for long waves and high temperatures, but is otherwise so hopelessly at variance with experiment as to suggest that something may have been overlooked in the application or interpretation of the equations.

Some of my correspondents point out that Nichols and Hull have already shown by experiment that the pressure of a beam of light is equal to the energy density irrespective of wave-length. According to my theory, the mechanical effect which they measured should be equal to the total energy density, $E/v+p$, as deduced from their energy measurements. Their result is in perfect agreement with my theory, but it is not quite such a simple matter (and may even prove to be impossible) to measure p separately from E/v, which is the experiment that I proposed to attack.

H. L. CALLENDAR.

Imperial College of Science, S.W., December 27, 1913.

Atomic Models and X-Ray Spectra.

MR. H. G. K. MOSELEY has published in the December issue of the *Philosophical Magazine* a very interesting paper describing his measurements of the wave-lengths of the characteristic X-ray lines of various metals. He has succeeded in calculating the wave-lengths of one-half of the lines he observed, assuming Bohr's atom and supposing the positive charge on the nucleus to correspond to the place of the element in the periodic table as suggested by van den Broek. He concludes that the agreement between calculated and observed wave-lengths strongly supports the views of Rutherford and of Bohr.

It appears to me that Moseley's research really only supports the views of Rutherford and of van den Broek. As I propose to show in detail in a paper to be published shortly in the *Verhandlungen der deutschen physikalischen Gesellschaft*, the relation between the wave-length and the positive charge may be obtained in a large number of different ways. For the present it may suffice to point out that it may be derived from a simple consideration of the dimensions of the quantities involved.

The frequency ν can only be supposed to depend upon the magnitude of the positive and negative charges Ne and ne, upon the mass of the moving charge m, upon the distance between the charges r, and, if we wish to introduce the quanta, upon Planck's element of action, h. As Nne^2, m, r, and h must be combined in such a way that the dimension of the resulting quantity is that of one finds

$$(NnML^3T^{-2})^x M^y L^z (ML^2T^{-1})^u = T^{-1}, \text{ or}$$

$x+y+u=0$, $3x+z+2u=0$, and $-2x-u=-1$, whence $y=x-1$, $z=x-2$, and $u=1-2x$.

It is interesting to see what assumptions are necessary to produce an approximate agreement with the experimental data if one inserts various values for x.

If $x=0$ we find $\nu = \text{const.} \dfrac{h}{mr^2}$, the constant being of the order unity as Einstein pointed out. Assuming the characteristic X-rays to be due to the movement of a single electron, we must suppose r to be proportional to $1/N$, where N corresponds to the number of free positive charges on the nucleus found by Rutherford and van den Broek. Roughly speaking, this would be the case if the repulsive force keeping the electrons away from the centre were proportional to $1/r^3$, as suggested by Sir Joseph Thomson. If $x=\frac{1}{2}$ we find $\nu = \text{const} \sqrt{\dfrac{nNe^2}{mr^3}}$. This formula is interesting, as it does not contain h, *i.e.* it may be derived from the ordinary laws of mechanics. It also reduces to Moseley's formula if $r \sim 1/N$.

If $x=1$ the formula is $\nu = \text{const.} \dfrac{nNe^2}{hr}$. If one electron is supposed to oscillate, r must again be assumed proportional to $1/N$ to fit the facts. If all $n=N$ electrons oscillate, r must be supposed to be constant. In this case the formula accounts also for the second series of lines which Moseley's formula fails to do. They may be calculated with great exactitude by putting $\nu = \text{const.} \dfrac{N(N-1)e^2}{hr}$, which corresponds to an atom which has lost an electron.

If we put $x=2$ we find $\nu = \text{const.} \dfrac{n^2N^2e^4m}{h^3}$, which is obviously identical with Moseley's formula, if we suppose only one electron to oscillate. The agreement of Bohr's constant with experimental data is not convincing to my mind in view of the large number of arbitrary assumptions in his derivation.

All the above formulæ are independent of the choice of any special model. They are selected so that the expression for ν is successively independent of e^2, h, m, or r. They would seem to prove that Moseley's figures need not be taken to confirm Bohr's views on the constitution of the atom. The only essential assumption common to all of them is that N should correspond to the place of the element in the periodic table approximately as suggested by Rutherford and van den Broek, and it would seem therefore that this hypothesis only can be said to be supported by Moseley's experiments.

F. A. LINDEMANN.

Sidmouth, December 28, 1913.

The Plumage Bill.

SIR HARRY JOHNSTON'S plea for the Plumage Bill in NATURE of December 11 will, no doubt, be considered an acceptable contribution by those who believe they possess the mental altitude to which he was born. I venture, however, to suggest that if he and his friends will leave their high mental estate and descend to the plain facts that business men must consider in this lower sphere, he will be obliged to admit that, like the trade, the educated naturalist has much to learn.

He admits the glaring defects of the Plumage Bill, but welcomes the measure as better than none. If he and his friends are able to conceive nothing more than an admittedly bad Bill, that will have no effect on bird-life, he is scarcely justified in his abuse of those who are willing, and trying to solve the problem of saving both the birds and the trade.

His presumption that none but an educated naturalist knows how the skins are procured, or the approximate habitat of the birds, or their right name in English or Latin, does not raise the controversy to any higher plane. Was he not an educated naturalist who bestowed the name of Apoda upon one of the species of paradise bird, believing it be born without feet? In 1908, before the Select Committee of the House of Lords, did not Sir Harry Johnston's friend, Mr. Buckland, declare that the destruction of birds of paradise was at that time so rapid that the species could not last more than two or three years? I see little more in the article which Sir Harry Johnston quotes from *The Times of Ceylon* than a confirmation of the trade statements that the birds of paradise are collected under a system regulating their killing, and that the family is in no danger of extermination. The article shows the valuable commercial asset that Dutch New Guinea possesses, and that its Government is taking full advantage of it under an adequate system of protection.

Mr. Buckland will be surprised to hear that there are so many birds left that this year's production is likely to result in a trade of about 200,000 skins, but he will perhaps be pleased to know that I do not believe it. Both gentlemen should be more concerned in those beautiful specimens said to fetch as much as 40*l.* or more. These are undoubtedly the rare and disappearing species that have no trade interest, but are eagerly sought after for scientific purposes. Even though they be the last survivors of their kind and need some stronger measures than any existing, in order to prevent their utter extermination, supporters of the Plumage Bill have conceived nothing more than a measure that permits their import until none are left, and also prohibits the import of species that are plentiful.

L. JOSEPH.

Plumage Committee of the Textile Trade Section of the London Chamber of Commerce,
Oxford Court, Cannon Street, London, E.C.
December 17.

My reply to Mr. Joseph is as follows:—

I only admit the defects of the proposed Plumage Bill in that it is not sufficiently drastic. But I am always one of those who think half a loaf is better than no bread, and that great restrictive or revolutionary measures of legislation are seldom carried all at once. I should like to see British officers and tourists restrained from destroying the wild mammalian fauna throughout the British Dominions; meantime I welcome sporting licences, close times—any measure which may tend to prolong the existence of interesting wild beasts. So although I should prefer a more complete exclusion from this country of the plumage of rare and remarkable wild birds, I am prepared to accept Mr. Hobhouse's Bill as an instalment of protective legislation.

I continue to assert the utter ignorance of their trade and of the sources and correct nomenclature of their goods which characterise the firms trading the skins and plumes of wild birds. The fact that Linnaeus and other naturalists of the eighteenth century exhibited ignorance of the nature of paradise birds is no parallel and no excuse. Mr. Buckland's reference was to the Great bird of paradise, which, I believe, is not far off extinction. Mr. Emery Stark's figures of 200,000 birds of paradise skins obviously refer to the many species inhabiting Dutch New Guinea and western Papuasia generally. In all there are some eighty-one or eighty-two distinct species of paradise birds, many of them confined to small areas, the majority living—unhappily—under Dutch rule; and about twenty species are nearly extinct by now on the smaller islands owing to the ruthless proceedings of the Malay, Papuan, and half-caste hunters. The females of some species, it must be remembered, are beautiful enough in plumage to be shot for the feather trade; this is also the case with the young males. It is possible, also, that most of the members of this group are monogamous, or that, like the peacocks and other extravagantly beautiful birds, *only the quite adult males* are fit for breeding. However it may be, all trustworthy authorities are agreed that the numbers of the paradise birds throughout Dutch Papuasia have very greatly diminished during the last thirty years, and that species common in Wallace's day are now extinct in this or that island or forest area.

The Government of the Dutch Indies has set on foot no efficient measures of protection—so far as I know, no measures at all, other than the issuing of licences to kill. I visited Holland two years ago to inquire into this matter, and was truly surprised to find the utter indifference with which it was regarded, even by Dutch zoologists; and Holland has produced some very great zoologists within the last fifty years. I deplore this mental lacuna which is, I fear, to be met with also among British biologists. But I am convinced it will disappear with the general spread of enlightenment. The same Dutchmen and Englishmen are exceedingly keen about the preservation of Dutch and British wild birds; they are simply thoughtless as to the rest of the world, forgetting that the new generation of dwellers in the British and Dutch Empires may daily curse the memories of the rulers of to-day who permitted a marvellous fauna of beautiful, wonderful, and harmless creatures to be extirpated solely for the gratification of the blood-lust among our sportsmen or the furnishing of wares for sale to silly women and magpie men.

A correspondent of *The Times* wrote the other day asking that the rose-ringed parrakeets of India might be handed over for destruction to the plumage trade. He must have been a person without a sense of beauty and colour-blind; for if there is, or was, one feature more than another that was lovely in Indian landscapes and old Indian towns it was the flocks of these grass-green, rose-tinted, or blossom-headed parrakeets. "But they ravage the natives' crops," he wrote. Well, I know India pretty well, and at one time spoke Hindustani sufficiently to converse with native landowners and peasants. I have never heard one such person complain seriously of the damage or loss done by these fluttering morsels of loveliness; but I have noted—as Rudyard Kipling and his father have noted—the many pet names in the vernacular for the parrakeets of India, and the native appreciation of their beauty. This is purely a native and a local affair. If the native of India wishes to thin out the parrakeets or other seed- or fruit-eating birds, *let him do so*; but do not permit it to be done for the infamously inadequate purpose of decorating Englishwomen's hats.

I remember in 1895 some British officers in north-west India decided that so many wild peacocks (they were semi-tame) must be "a dam' nuisance" to the native agriculturists and started out to organise a battue. But the battue was the other way about. The natives of the district, losing all restraint at the idea of their beautiful peacocks being slain to please the Sahib-lōg and the Gora-lōg, turned out with long sticks and thoroughly whacked the shooting-party. This episode was one of the many signs of unrest in India which characterised the year 1895. In this instance, if not in the others (for in most cases it was excellent measures of sanitation which provoked ignorant wrath), I thoroughly sympathised with the natives.

Mr. Joseph refers to paradise-bird skins worth in the trade 40*l*. or more, and states that these are eagerly sought after for scientific purposes. What nonsense!—unless he refers to pseudo-science. The true scientific ornithologist has by now in the collections of Britain, Italy, Germany, Holland, and France all the material he can possibly want for the external description of paradise birds. If he desires anything else it is in the way of the bodies of these birds. But even their myology, osteology, intestines—all their anatomy—are by now completely understood. We have, however, to learn much more about their life habits, their eggs, nests, and food. Material in such a quest can only be gathered by a trained scientific observer, such as from time to time is sent out by a learned society or a patron of learning. Scientific men would not go to the plumage-trading firms for such information, for they would not get it, or it would be quite untrustworthy. These firms buy their skins at second-hand, third-hand, fourth-hand, and their ignorance on the subject of ornithology is simply colossal.

I want to narrow the discussion to these unanswerable points. What are the legitimate uses of the skins or plumes of wild birds (excepting such as are carefully protected from diminution by rigid supervision and close times for breeding) in a civilised community—a community civilised enough to appreciate the economic uses of birds and the extreme beauty of birds in a landscape? Do the bodies of the birds I would desire to protect from the plumage-hunter serve as important articles of palatable food? No; except it be in a few instances, so few that they are of no importance in the argument. Do they serve to keep women, especially poor women, warm? No; quite useless for that purpose. Admitting that feathers and plumes do add to the beauty of a woman's costume, are we sufficiently supplied with such by using what we get from birds bred for the purpose or bred or protected for our food supply? Yes. From a hundred species and varieties. In all these circumstances a woman who wants to wear a humming-bird or a parrot's wing or a bird of paradise or egret plume must be depraved, and should not be pandered to and the trade which would live by ministering to such tastes should be closed down without compunction.

H. H. JOHNSTON.

A Palæobotanical Institute at the Royal Botanic Gardens, Kew.

MORE than two years ago there appeared an article in *The Times* (August 24, 1911) the title of which was "A Neglected Science: Fossil Botany and Mining." The chief contents of this article can be summed up as an appeal for the recognition of palæobotany, and was indeed thus named in NATURE of August 31, of the same year. The author of the article in *The Times* criticises "the official neglect of palæobotany in this country." It is admitted that the leadership of some branches of palæobotany is found in Britain, but this is stated to be wholly due to the zeal and interest of some private gentlemen and to some professors of modern botany who "spend their whole leisure from their professional duties in the arduous labour of palæobotanical research."

But "there is no professorship of palæobotany at any of our universities or colleges. There is no lectureship or readership in palæobotany at any of our universities or colleges; and Cambridge alone has a demonstratorship, which is so ill-paid that it might be thought libellous to state the official salary attached. There is no post of palæobotanist to our Survey. . . . There is no post of palæobotanist at our great national Natural History Museum."

After having shown what has been done for palæobotany at Berlin, Stockholm, and Washington (U.S. Geological Survey), and after having developed the reasons—scientific and economic—why palæobotany should receive official support in Britain also, the author asks: "What should be done?" and supplies the following answer:—

"Much in the future. For the present what is urgently needed are professorships and lectureships at one or two of the universities—a professorship, for instance, in London, which would reach the geological students who go out from the School of Mines to all parts of the world. Then two posts at least should be established at the British Museum of Natural History: one for a palæobotanist of standing and repute who has travelled, who with a wide knowledge of the subject could fitly represent the science, and who, keeping abreast of the subject, could direct the work of a junior, and ultimately of several juniors. In our museum at present there are many specialists on animal fossils, and an important department of animal palæontology, while the palæobotanical department does not exist, and though there is a valuable collection of fossil plants the authorities only get in outside specialists from time to time to write monographs on them.

"What is ultimately wanted for the science is a properly equipped institute of palæobotany, which should represent all its sides—with a well-arranged museum, an academic and also economic side to its activities. The immediate need for the foundation of some posts in palæobotany should give trustees and governors food for thought, and might give some millionaire, anxious to be of service to his day and generation, an opportunity to do a unique and serviceable deed in endowing this neglected but important science."

The same appeal for the recognition of palæobotany as in the article referred to has recently been taken up again by Dr. Marie C. Stopes, in a lecture delivered at University College (University of London), on October 17, and published in an abridged form in NATURE of November 20, 1913. To the question what the palæobotanist in the future will demand the following answer is given:—"That in at least *one* institution in each civilised country there shall be a recognition of his science and adequate accommodation for it." after which the plan and details for such an institution, according to the opinion of Dr. Stopes, are fully developed for which the number of this journal cited should be consulted.

It is earnestly to be hoped that this proposition will be realised, and at the same time realised in the right way. As keeper of the palæobotanical department of the State Museum of Natural History (Naturhistoriska Riksmuseum) at Stockholm, which was specially mentioned in the article referred to, I may be permitted to express my opinion regarding the proposed palæobotanical institution. I have, it is true, no idea of the present position of the question here discussed, nor if there is any possibility of the realisation of the plan proposed below. But I hope that my British fellow-workers will not consider my suggestion as an intrusion, since they are probably aware of my deep interest in British palæobotany, by which I have profited so much myself during repeated visits to Britain.

I quite agree with Dr. Stopes that the establishment of a properly equipped British institute of palæobotany is a most urgent need, which ought not to be postponed. But in order to give such an institute an opportunity for working under the best conditions possible, I consider it almost necessary that it should be established in connection with the Royal Botanic Gardens, Kew. The reason for such a connection is simply this: that the scientific study of palæobotany signifies a constant and repeated comparison of the fossil plants with the recent ones. For the botanical determination of Palæozoic and Mesozoic plants the palæobotanist must compare the recent Pteridophytes and Gymnosperms, especially the tropical ones; and there exists no better opportunity than in the Kew Gardens, where the hothouses, temperate houses, museums, and herbaria offer the most excellent and complete materials possible for such work. The same holds true for the determination of dicotyledonous leaves of the Cretaceous and Tertiary. The determination of those leaves is a most difficult task, for which an extensive and repeated comparison with the leaves of trees and shrubs of the arboretums and gardens, of the temperate houses and hothouses, and, ultimately, of the herbaria is necessary. There is no other place in the United Kingdom which offers such excellent opportunities for this work as the Kew Gardens; and the same holds true for the determination of leaves, fruits, and seeds from the Quaternary also. It therefore seems evident that the Kew Gardens are the right place for the establishment of a palæobotanical institute, the headquarters for the British palæobotany of the future.

A. G. NATHORST.

Stockholm, December 12, 1913.

Electrodeless Spectra of Hydrogen.

WHILE making experiments on the apparent production of neon and helium during electric discharges, I have noticed an effect which may be of interest to spectroscopists. A powerful oscillatory discharge is produced in eight or nine coils of wire from two Leyden jars, with a spark-gap of about 2 in. in parallel, connected to a large coil which is run from the main supply. Set in the coils of wire is a glass bulb of about 300 c.c. capacity provided below with a small bulb containing cocoanut charcoal, and connected by a side-tube and tap with a mercury pump. After evacuating, heating, and "washing out," the bulb with hydrogen, when pure hydrogen is admitted at a fairly low pressure and the discharge is passed, the glow is bluish in colour, and shows both hydrogen and mercury spectra; but if the charcoal bulb be cooled in liquid air so that mercury vapour and any other impurities are completely removed, the glow is of a brilliant rose colour, and shows only hydrogen lines. If the pressure is reduced, however, to a value somewhere below 1 mm., there appears in the middle of the rose ring a fairly bright blue zone; and whereas the former shows both the simple and complex spectra of hydrogen, the blue zone shows nothing but the elementary line spectrum; and, moreover, the blue line $\lambda 4861$ is more intense than the red line. Further reduction of pressure causes the obliteration of the blue zone by the spreading inwards of the rose ring.

As I have not found any mention of this isolation of the primary spectrum, with weakening of the α line, in pure dry hydrogen, the fact is possibly worth recording.

IRVINE MASSON.

University College, London, December 11.

BIRDS, GAME, AND TREES.[1]

MR. KEARTON'S books on British birds (1) are so well, and deservedly, known, that the new edition of his work entitled "British Birds' Nests" calls for only a brief notice. The original edition first saw the light in the autumn of 1895, and was the first book of its kind to be illustrated throughout by means of photographs taken direct from nature, and was declared by the late Dr. Bowdler Sharpe to "mark a new era in natural history." This was followed in 1891 by another volume, entitled, "Our Rarer British Breeding Birds." The present revised and enlarged edition of the first work contains the best of the pictures that appeared in the pages of the second, together with numerous photographs secured during the intervening years. To give an idea of the time and labour expended in gathering materials for this book, it may be mentioned that Mr. Richard Kearton, with his brother, Mr. Cherry Kearton, to whom, we understand, most of the photography is entrusted, have travelled more than thirty thousand miles and exposed more than ten thousand plates to secure the necessary illustrations of nesting sites and birds. In addition to the photographs, the book is illustrated with fifteen coloured plates of eggs.

Within the last ten years or so, the question of the preservation of wild animals from extermination at the hands of sportsmen and traders, who serve the fur and feather markets of the world, has pushed itself insistently to the front, and Dr. Hornaday's powerfully worded appeal (2) for the instant passing of legislative measures to arrest the imminent extinction which threatens some of our finest mammals and most beautiful birds—an appeal backed by incontrovertible statistics—is addressed to the sportsmen and governing bodies of every civilised state in the world. Much has been attempted already in this direction both in America, Africa, and Australia; but Dr. Hornaday's investigation of the question so far as Canada and the United States are concerned has revealed "a mass of evidence proving that . . . the existing legal system for the preservation of wild life is fatally defective," and that those who imagine the protective measures to be effectively operative are living in a fool's paradise. In a great measure this is due to the circumstance that fully 90 per cent. of the protective laws have been practically dictated by the killers of the game, with the result that in all but a few instances "open seasons" for slaughter have been carefully provided for so long as any game remains to be killed. According to Dr. Hornaday, whose authority in such a matter no one will be prepared to dispute, the point has now been reached where a choice has to be made between the enforcement of long closed seasons and a gameless continent!

An osprey and its eyrie. From "British Birds' Nests."

[1] (1) "British Birds' Nests: How, Where, and When to Find and Identify Them." By Richard Kearton. Illustrated from Photographs by Cherry and Richard Kearton. Pp. xii+520+plates. Revised and Enlarged Edition. (London: Cassell and Co., Ltd., 1913.) Price 14*s.* net.

(2) "Our Vanishing Wild Life: Its Extermination and Preservation." By Dr. W. T. Hornaday. Pp. xvi+411. (New York; Charles Scribner's Sons, 1913.) Price 1.50 dollars.

(3) "Trees in Winter: Their Study, Planting, Care and Identification." By Dr. M. F. Blakeslee and Dr. C. D. Jarvis. Pp. 446. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

The first part of the book tells the pathetic tale of the causes and factors of extermination, mainly of birds and mammals, in process all over the world, from the song-birds of Europe and the Southern States of America, to the pheasants of the east and the big game of Africa. In the second part he deals with the economic and other reasons for the preservation of species, with the laws that should be passed to achieve that end, with game reserves, &c. The book is well illustrated with figures of many of the interesting species threatened with extermination, and with maps showing their past and present distribution.

"Trees in Winter" (3) is essentially a work on arboriculture. By the term winter the authors mean that period when the tree is in its resting condition, a period which may be considered to extend from the shedding of the leaves in the fall to the bursting of the buds in the spring, which varies for different trees in different localities. In the north-eastern United States, for instance, it may begin as early as the latter part of September, and may extend even into the middle of May.

The subject-matter is divided into two parts. Part i. deals with the buying, planting, and care of trees mainly during their dormant condition, but it also contains much valuable information, and many important hints on spraying and the treatment of fungus growths and insect pests during the growing season. It was written primarily for the use of those who possess trees of their own in gardens or parks, and not for a municipal tree-planting commission. Nevertheless, it will be of inestimable service to those responsible for the well-being and upkeep of trees in the streets and public squares within city precincts. This part was specially written at the request of the publishers as an economically useful addition to part ii., the material of which first appeared in pamphlet form as a bulletin of the Storrs Agricultural Experiment Station, and proved in such demand, especially for use in schools, that it seemed desirable to issue it in book form, and thus render it more widely available than would be the case if its circulation were restricted to the limitation of a State publication. This part deals with the identification of trees. It leads off with an analytical key to the genera and species; and this is followed by detailed descriptions of the species, systematically arranged, every species being illustrated by photographs showing its mode of growth, its twigs, fruit, and other structural details.

Although the trivial names employed are not always the same as those used in England—what we commonly know as the plane tree, for instance, is called the sycamore—this fact will in no way detract from the value of the book to arboriculturists in this country, because the admirable descriptions and pictures make confusion of the species impossible.

R. I. P.

THE MINERAL RESOURCES OF THE UNITED STATES.[1]

The record of the annual mineral production of the United States has now increased in size until it occupies two large volumes of 2242 pages in all. These form a storehouse of information concerning a number of matters connected directly or indirectly with the mineral industry of America, whilst statistics of, and information about, the production of minerals in other parts of the world are given for the purpose of comparison. The methods are the same as those employed in previous years, one of the two volumes being devoted to the metalliferous minerals and the other to the non-metals. From the economic point of view the latter are the more important, the value of the coal production of the United States being nearly one-third of the total value of the whole of the mineral products, this latter amounting to the huge sum of close upon 400,000,000*l*. As the population of the United States is just about 92 millions, the annual mineral production amounts to well over 4*l*. per head of the population.

The above total shows a small decrease, equal to 2·65 per cent., on the value of the production in 1910, in which latter year the record value attained in 1907 had again been nearly reached. Practically the whole of the above drop was due to a decline in the value of the pig-iron production, the statistics for the metalliferous minerals being based, as in previous years, upon the metals produced from the ores, and not upon the ores themselves. The production of pig-iron in 1911 was 23,649,547 tons, as against 27,303,567 tons in 1910, a decrease of 13·3 per cent., whilst the output of iron-ore declined simultaneously from 51,155,437 tons to 40,989,808 tons, equal to a decrease of 23·4 per cent. The only cause that can be assigned for this decrease was over-production in 1910, which necessarily caused a decreased demand in 1911. It is quite certain that this decrease was in no way due to natural causes, the capacity of the mines to produce the requisite supply of iron-ore being in no way diminished.

The output of gold was practically unchanged, whilst that of silver showed a moderate increase; in the same way there was but little difference in the copper production, whilst in the production of lead and zinc increases were shown, though in no case of any great importance.

The coal output in 1911 was but little less than in 1910, namely, just over 496 millions of tons, as against about 501½ millions of tons in 1910. In 1911 the production of petroleum, on the other hand, showed an increase, namely, 220½ millions, as against 209½ millions of barrels.

In a similar way fluctuations, though not to any marked extent, occur in the less important mineral products, but the net result left by the perusal of these statistics is the distinct impression

[1] "The Mineral Resources of the United States, Calendar Year 1911. Part i. Metals. Pp. 1013. Part ii Non-metals. Pp. 1224+maps. (Washington: United States Geological Survey, Government Printing Office, 1912.)

that the mineral industry of the United States is in a sound and flourishing condition, and that the vast mineral resources of that great country are being steadily and profitably developed.

As to the volumes in which the results of these operations are chronicled, it is impossible to do more than express admiration for the care and attention bestowed upon them, and we can only wish that we had in this country a department capable of doing anything like similar justice to our own British mineral industry. H. L.

SIR TREVOR LAWRENCE, BART.

SIR TREVOR LAWRENCE, late President of the Royal Horticultural Society, and sometime Treasurer of St. Bartholomew's Hospital, died at his seat at Burford, Dorking, in his eighty-second year, on Monday night, December 22. Born on December 30, 1831, Sir Trevor was educated at Winchester, and afterwards at St. Bartholomew's Hospital, where his father was one of the staff and one of the teachers. After qualifying as a medical man, Trevor Lawrence joined the Indian Medical Service in 1853, seeing much active service during the Mutiny. In 1863 he retired from India, and in 1867 succeeded his father as second baronet. In 1869 he married Elizabeth, daughter of the late Mr. J. Matthew, of Burford, Dorking. From 1875 till 1892 he sat in Parliament.

Always interested in plants, Trevor Lawrence became during his Indian service a keen and successful gardener. This taste and talent he exercised and developed on his return to England, and although he was doubtless best known in gardening circles as an orchid grower, there was no particular branch of horticulture in which he was not keenly interested and in which he was not highly successful. Even in that especial branch of the craft in which he was deservedly famous—the cultivation of orchids—his innate love of plants for their own sake, which he appears to have inherited from his mother, was very conspicuous. In addition to one of the finest private collections of showy sorts, Sir Trevor had at Dorking probably the largest private collection of the less conspicuous, but very often more scientifically interesting genera and species from both hemispheres.

There was therefore everything that was appropriate in the election of Sir Trevor, in 1885, to the presidentship of the Royal Horticultural Society. But on Sir Trevor's part there was also a strong strain of chivalry and gallantry in his acceptance of this, at that time, thankless post. The Society was at a miserably low ebb, with an inadequate membership and still more inadequate finances. Supported in the struggle which ensued by a number of far-seeing and courageous colleagues, both against adverse external circumstances and against opposition from within the Society, the difficulties were overcome, and the assured financial position in which the Royal Horticultural Society stands to-day has been largely due to the steadfastness of purpose, tact and wisdom of Sir Trevor Lawrence during the presidentship of twenty-eight years, which ended with his retirement from that position on April 1 last.

Almost as great as the services he was able to render to gardening were those which Sir Trevor rendered to his own old hospital, the treasurership of which he was invited to undertake when he retired from Parliament. This post he held during twelve years of financial and other difficulties. The qualities which had stood him in such good stead in the Royal Horticultural Society enabled him here again to inaugurate much that was useful in the matter of extending the scientific equipment of the hospital, of securing for the staff some share in its management, and of establishing a sounder administrative policy with regard to its property. As a member of the council of King Edward's Hospital Fund, Sir Trevor was able to do much for the cause of hospitals generally.

A well-known and skilled collector of Chinese and European porcelain and the possessor of one of the finest collections of Japanese lacquer in Britain, Sir Trevor placed students of the latter under much obligation by printing for private circulation in 1895 a finely illustrated catalogue of his collection. A host of exquisite courtesy, and a counseller of great sagacity, Sir Trevor's death will be greatly mourned by a wide circle of friends.

A NEW BRITISH ANTARCTIC EXPEDITION.

THE science of geography will enlarge its bounds if the expedition to the South Pole, planned by Sir Ernest Shackleton, ends successfully. A start is to be made next October from Buenos Aires, and the plan proposed is to cross the south polar continent from the Weddell Sea, on the Atlantic side, to the Ross Sea, touching at the South Pole *en route*—a distance of some 1700 miles. Altogether the party will number forty-two, twelve being actual explorers, and the remainder the crews of the two ships that are to support the venture, one on each side of the Antarctic continent. Of the explorers, six expect to cover the whole ground from the point of landing on the Weddell Sea to the point of embarkation on the Ross Sea. The other six will be divided into two groups: one, composed of a biologist, a geologist, and a physicist, will probably remain at an experimental station on the Weddell Sea side; the other party of three will be told off to explore the land to the east, which is at present entirely unknown. These two wings of the expedition will eventually be taken back to South America, while the party which will accompany Sir Ernest across the continent is to be met at the Ross Sea base by the second ship from New Zealand, whither it will take them.

For the outward journey the *Aurora* has been chosen. Both this and the sister vessel will depend for fuel on oil, and not on coal. The advantage of this arrangement of being free from ballast need scarcely be expatiated upon; when the oil is used up, water can be pumped into its place. Both ships will also be fitted with cages and tanks for bringing home live seals and penguins. Moreover, the *Aurora* will have a gyroscopic compass, which will therefore not be affected by magnetism in the ship. The expedition will be fitted with a wireless installation—one of about 500 miles' radius. But more useful still, two sledges driven by aëroplane propellers, with aëroplane engines, and an aëroplane with clipped wings to glide over the ice, are being taken. The team of trained dogs numbers 200. The expedition will be equipped for two years, and is to be known as "The Imperial Antarctic Expedition." The minimum cost is 50,000*l.*, and this amount has been provided by the generosity of a friend. In order to equip the expedition with full efficiency, however, 60,000*l.* or 70,000*l.* would be required. No public appeal is to be made for subscriptions to make up the additional amount, but contributions for this purpose will be welcomed and will be of service.

The following statement as to scientific work contemplated was made by Sir Ernest Shackleton on Monday:—

No one knows whether the great plateau dips gradually from the pole towards the Weddell Sea, and no one knows whether the great Victoria chain of mountains, which has been traced to the pole, extends across the continent and links up with the Andes. The solving of the problem is of intense interest to geographers all over the world, and the discovery of the great mountain range, which we assume is there, will be one of the biggest geographical triumphs of the time.

The geological results will be of the greatest interest to the scientific world. The expedition will at its winter quarters make geological collections, also typical rocks will be taken on the journey if we come across exposed rocks when crossing the mountain ranges. One ship will land parties for the purpose of making geological collections on the west side of the Weddell Sea, and the ship will at the same time trace, if possible, the continuation of Graham Land southwards.

The expedition will take continuous magnetic observations from the Weddell Sea right across the pole, and the route followed will lead towards the magnetic pole and make an ideal method of determining the general dip of the magnetic needle. This magnetic work has a direct bearing on economic conditions, in that an absolutely true knowledge of magnetic conditions is of use to ships in navigable waters. I also propose to set up a magnetic observatory at winter quarters and take continuous magnetic observations throughout the winter. On my last expedition we could only take field magnetic observations, as, owing to lack of money in the first place, I could not afford to provide a large magnetic equipment, though we did important work, as one of the parties reached for the first time the south magnetic pole.

The meteorological conditions would be carefully studied, and would help to elucidate some of the peculiar problems of weather that at present are only dimly recognised as existing. Continuous meteorological observations, both at winter quarters and on the journey across, are of extreme importance, and the results can be correlated with the observations of the last three expeditions in the Antarctic.

Biological work will be thoroughly carried on, and the distribution of fauna and plant life will be studied. Both ships will be equipped for dredging and sounding.

All branches of science will be most carefully attended to, and the net result scientifically ought to be a large increase to human knowledge, but, first and foremost, the crossing of the polar continent will be the main object of the expedition.

NOTES.

The Academy of Sciences of Bologna has elected Prof. Silvanus P. Thompson as a corresponding member in the class of physical science.

At the last meeting of the Academy of Sciences in St. Petersburg Sir William Ramsay was unanimously elected an honorary member of the academy; he was previously a corresponding member.

Sir Howard Grubb, F.R.S., has been appointed scientific adviser to the Commissioners of Irish Lights, in succession to the late Sir Robert Ball, who held the position for the past twenty years.

In a flight from the naval aërodrome at Fréjus, France, on December 27, M. Legagneux, succeeded in reaching a height of 20,300 ft., which is the greatest altitude yet attained with an aëroplane.

The next grants from the Elizabeth Thompson Science Fund will be made in February, 1914. Applications should be sent to the secretary, Dr. Charles S. Minot, Harvard Medical School, Boston, Mass., before February 1.

We regret to see the announcement of the death, on December 26, at fifty-three years of age, of Mr. W. Popplewell Bloxam, formerly professor of chemistry in Presidency College, Madras, and the author of a number of reports and papers on the production and chemistry of indigo.

Mr. W. Lawrence Balls, botanist to the Egyptian Government, Department of Agriculture, has just left the service of the Government, his agreed term of years having expired, and is returning to Cambridge to work up unpublished data on cotton accumulated since his appointment to the staff of the Khedivial Agricultural Society as cryptogamic botanist in 1904, and in the post he has now vacated.

Men who have been trained at the Royal Botanic Gardens, Kew, occupy posts in botanic gardens in most parts of the world. The following new appointments of members of the gardening staff at Kew are announced in the *Kew Bulletin*:—Mr. G. S. Crouch, to be assistant director of horticulture in the Egyptian Department of Agriculture; Mr. T. H. Parsons, to be curator of the Royal Botanic Gardens, Peradeniya, Ceylon, in succession to Mr. H. F. Macmillan, who has been appointed superintendent of horticulture in the department of agriculture, Ceylon; Mr. C. E. F. Allen, to be curator of the Botanic Garden, Port Darwin, Northern Territory, South Australia, in succession to Mr. N. Holtze, deceased.

Prof. E. B. Titchener asks us to announce that a prize of one hundred dollars is offered for the best paper on the availability of Pearsons formulæ for psychophysics. The rules for the solution of this problem have been formulated in general terms by Dr. W. Brown. It is now required (1) to make their formulation specific; and (2) to show how they work out in actual practice. This means that the writer must show the steps to be taken, in the treatment of a complete set of data, for attainment in every case of a definite result. The calculations should be arranged with a view to practical application—*i.e.* so that the amount of computation is reduced to a minimum. Papers in competition for this prize will be received not later than December 31, 1914, by Prof. E. B. Titchener, Cornell Heights, Ithaca, N.Y., U.S.A. Such papers are to be marked only with a motto, and are to be accompanied by a sealed envelope, marked with the same motto, and containing the name and address of the writer. The prize will be awarded by a committee consisting of Profs. William Brown, E. B. Titchener, and F. M. Urban.

The use of distributed inductance in telephone cables which was advocated many years ago by Mr. Oliver Heaviside, and was put into practice more recently by Pupin, has not only resulted in great economies in copper on long-distance telephone lines, but also has enabled submarine telephone cables to be brought into use for far greater distances than formerly. The most recent achievement in this direction is the laying last month of a cable sixty-four nautical miles in length between Nevin, in Carnarvonshire, and Howth, about eight miles from Dublin. Hitherto telephony between England and Ireland has been carried on through a cable twenty-four nautical miles in length between Port Mora (near Portpatrick) and Donaghadee, in connection with long land lines on both sides of the Channel. The new cable, which was manufactured by Siemens Bros. and Co., has four conductors weighing 160 lb. per nautical mile, and insulated with a special gutta-percha with a low leakance, weighing only 150 lb. per nautical mile. At distances of one nautical mile apart, inductance coils are inserted in each of the four cores. These are long narrow double-wound coils, each with an inductance of about 100 millihenrys. Their construction is such that they are enclosed in the gutta-percha covering in the same way as the cable itself, and the armouring is carried right over them.

In the South American Supplement of *The Times* for December 30, attention is again directed to the possible effects of earthquakes on the Panama Canal. While retracing much of the ground covered in our former Notes on the subject, Prof. J. Stuart refers to several points that are worthy of consideration. The general belief as to the safety of the massive concrete walls of the locks is based on the assumption that the locks have been laid upon solid rock. This is the case with the locks at Pedro Miguel and Miraflores, but those at Gatun are founded on beds of argillaceous sandstones, which were first described as indurated clays. Prof. Stuart points out that the fears as to the Gatun dam being opened by fissures are probably groundless, for the San Leandro dam which stores the water supply of Oakland was uninjured by the San Francisco earthquake. He refers in conclusion to the possible effects of the excavations. More than 200 million cubic yards of material have been removed from the various cuttings and deposited on the dams and elsewhere, and he suggests that this redistribution of stresses in the earth's crust might facilitate the occurrence of earthquakes.

The English Forestry Association, of which Lord Clinton is president, and Mr. M. C. Duchesne (Farnham Common, Slough, Bucks) secretary, proposes to hold a forest exhibition in London in 1914. The object of the exhibition is to encourage English timber industries. Commercially the private forest owner cannot usually hope to obtain the rate of interest he looks for, on anything but short-rotation copse, and it is exactly underwood that has fallen so disastrously in price. The English Forestry Association has strong hopes of reviving the failing industry in wooden barrel hoops. It seems possible also to get back to better prices for firewood. By burning firewood in a properly constructed stove a heating power can be obtained equal to that of coal in the ordinary domestic fireplace—an open stove with the fire showing, and a healthy mixture of both radiant and convection heat. If such stoves came into use there would be a better demand for firewood. But the experience of other countries shows that it is the working with a large scheme of State forestry that is the saving feature of private forestry, and the forestry exhibition would help to direct attention to the fact that the Development Commission, after three and a half years, has failed to carry out its Act and initiate State forestry in Britain, while the slow progress in Ireland is exciting adverse comment.

Major H. G. Joly de Lotbinière has contributed to *The Quarterly Review* for October a valuable and timely article on the position of forestry in England and abroad, in which he reviews the principal timber resources of the world, and the steps that have been taken in England and elsewhere to provide for the future. As he points out, experts in every country are agreed that the world's supply of timber is rapidly diminishing, and that unless vigorous steps are taken in the afforestation of suitable waste lands a shortage of material must be experienced long before the close of the present century. The author indicates in a general way the lines on which the work of afforesting the sixteen million acres of mountainous and heath land in this country should be proceeded with, and urges the necessity for immediate action.

The trustees of the British Museum have acquired recently a unique gold coin of extraordinary interest. It is the only known example of the gold coinage of the Anglo-Saxon King Offa (A.D. 757–96); and its value lies in the fact that, though struck by a Christian King, it bears a Mohammedan inscription in Arabic. Offa agreed to pay a tribute in gold of Peter's Pence, and he probably used the predominating gold currency of his day as the best model for his purpose, adding the inscription "Offa rex" to that already existing on an Arabic dinar which was coined about twenty years before his time.

The volume of the Transactions of the Bristol and Gloucestershire Archæological Society for 1912 is devoted to a descriptive catalogue of the printed maps of Gloucestershire, 1577–1911, by Mr. T. Chubb, of the Map Room, British Museum. The series begins with the map dated 1577 in Christopher Saxton's "Atlas of England and Wales," published in 1579, and is followed by that by Peter Keer, in his collection of twenty-eight maps of his "Counties of England and Wales," 1599. Thence the series of maps are continuous down to the present day. Among recent catalogues of county maps those by Sir H. G. Fordham for Hertfordshire, Mr. W. Harrison for Lancashire, and Mr. T. Chubb for Wiltshire are the most important. Mr. Chubb's catalogue is an excellent piece of work, and is provided with an admirable series of reproductions of the more important maps. It is to be hoped that other local archæological societies will follow this model in cataloguing the maps of the English counties.

That the use of coloured photography will prove to be an important addition to the resources of the anthropologist is clearly proved by the admirable series of photographs of the pagan races of the Philippine Islands, illustrating a paper on these people by Mr. Dean C. Worcester, in the November issue of *The National Geographic Magazine*. He gives a useful account of the relations between the American authorities and these primitive tribes, and of the attempts which are being made to bring them within the pale of civilisation by roads, schools, police, and the regulation of trade. The danger is that the process of reclamation may prove too effective, and that as they become civilised they will degenerate and decay. This consideration is no doubt present in the minds of the authorities, and they are unlikely to press our modern civilisation on these races further than is consistent with their preservation.

A report of sleeping sickness in the Island of Principe, by Surgeon-Captain Bruto da Costa, has been translated into English by Lieut.-Col. Wyllie, and published by Messrs. Baillière, Tindall, and Cox. It is believed that neither the disease nor the transmitting fly, *Glossina palpalis*, are indigenous in the island, but that the fly was introduced about 1825 with cattle from the gaboon. Atoxyl was found useless either as a prophylactic or as a cure of the disease; it was useful only as a tonic, prolonging life in animals experimentally infected. It is claimed that a considerable decrease in the incidence of the disease has been effected by measures consisting mainly of draining swamps, felling timber, clearing the undergrowth, and exterminating pigs in the regions infested by the tsetse-flies. It is well known that *G. palpalis* breeds near water, but the author suggests that it cannot do so under exposure to the direct light and heat of the sun, hence the importance of keeping the borders of marshes and brooks free from all vegetation or overhanging shade. The pigs are believed to afford the chief sustenance of the tsetse in the bush, and also to carry the flies about from place to place.

In a memoir entitled "Botanical Features of the Algerian Sahara," issued as Publication No. 178 of the Carnegie Institution of Washington, Dr. W. A. Cannon gives an extremely interesting account of his observations in southern Algeria and the western portion of the Sahara. The chief object of his tour, which extended over about six months, and included a journey of about a thousand miles through the more arid portions of the country, was to investigate the climatic and soil conditions of this region with special reference to the root-habits of the more striking species of the flora. The author's work on desert plants in North America enables him to draw interesting comparisons between the widely separated arid regions of Arizona and Algeria, and the concluding portion of this valuable memoir, which is illustrated by thirty-six fine collotype plates, gives one of the clearest and most complete accounts of desert vegetation that has yet been published. One of the most striking results of Dr. Cannon's investigations is his demonstration of the fact that, contrary to what might have been expected, the prevailing type of root in desert plants is neither that with a deep main axis (tap-root) nor that which spreads out horizontally near the soil surface (as found in most Cacti), but a generalised type which is adapted to a wider range of conditions. The Algerian desert is more intensely arid than Arizona, and while fleshy plants like the Cacti are a striking feature of the North American deserts, such plants are entirely absent in southern Algeria.

A paper by Mr. T. Thorne Baker, read on December 10 before the Royal Society of Arts includes an account of physiological effects of high-frequency currents. It was stated that the upper part of the plant is negative electrically as compared with the roots, and therefore the minute hairs on the leaves and stems would act as collectors to collect atmospheric electricity, which is usually positive in character. The fact that the plant itself acts as a battery, and possesses two poles of opposite sign, was taken to indicate that these feeble differences of potential are of intrinsic use in the natural processes of the plant, and it was stated that increase of growth can be obtained by the electric current. Experiments were described showing the effect of electric discharge on various organisms. The red variety of the American gooseberry blight was not killed by the discharge except where there had been a preliminary treatment with soluble sulphide. Cheese mites, however, were readily killed. Other results were quoted showing the effect of electric stimulus on animal life. It was stated that chickens will grow under such stimulus at about double the normal rate, whilst the mortality is considerably less than usual. Considerable care, however, is necessary in adjusting the ratio of current to voltage, the frequency of oscillations, and the quantity of electricity to the dimensions of the culture house.

The report of the Behar Planters' Association Indigo Research Station at Sirsiah for the year 1912–13, recently received, possesses the interest of being the last of its series. It includes a brief recapitulation by Mr. C. Bergtheil of the work done at this station during recent years, as well as an account of the work of the year under review, followed by an appendix of much interest by Mr. F. R. Parnell, reviewing the botanical work carried out at Sirsiah since October, 1909, for which he has been responsible. This work, it is explained, has been mainly devoted to the improvement of the plant grown, more especially in the direction of the selection of pure lines of the already cultivated plant possessing greater economic value than the ordinary mixed crop. This review of work done will repay perusal, and the reader will recognise in it a modest record of good work faithfully and conscientiously performed. To those, however, who at a time when the natural indigo industry as a whole is being hardly pressed by the competition of the synthetic indigo-maker, find their sympathies still with the Behar planter, the text of this ultimate Sirsiah report will supply food for thought that is not altogether comforting. Of the two Indigoferas that are mainly grown in Behar—*I. sumatrana*, which displaced *I. articulata* about a century ago, and *I. arrecta*, the introduction of which is a matter of only a dozen years ago—a rather disquieting account is given. As to the former, there is a record of miserable crops traceable, Mr. Bergtheil believes (p. 6), to the sowing of inferior seed; as to the latter there is a disheartening history by Mr. Parnell (p. 24) of "disease," which, so far, it has not been possible to attribute to fungal, insect, or bacterial attack, or to explain as the result of defective culture.

In the Journal of the Franklin Institute (October, No. 4) appears an important paper by Mr. Frank K. Cameron, of the Bureau of Soils, U.S. Department of Agriculture, on kelp and other sources of potash. After briefly reviewing the fertiliser problems of the United States, Mr. Cameron gives an account, illustrated by many photographs, of the movement recently started to utilise the giant "kelps" of the Pacific coast as a source of potash, which promises to develop into a very large and important industry. These giant kelps occur in numerous beds or groves, often of a vast extent, and are characterised by an exceptionally high content of potassium, five times on the average that of the better-known Atlantic algæ. They are said to form "an ample, perennial possible source of potash for the present needs of the United States." Until recently the harvesting of the kelp on a sufficiently large scale to make it a commercial possibility appeared the chief difficulty, but ingenious mechanical harvesters have been devised to overcome this. The costs of harvesting and utilisation are gone into in some detail, and it is pointed out that several soundly financed companies have already started operations on the large scale from which good results are anticipated.

In an interesting article contributed to the Proceedings of the R. Academy of Amsterdam (vol. xv.) by Dr. C. Braak an attempt is made to show that by means of the connection perceptible between barometric pressure and rainfall in the Indian Archipelago it is possible to make "a long-range weather forecast for the east monsoon in Java." With respect to deviations of air-pressure, the author states that Java has a special advantage, because the variations of climate there are determined by the variations of pressure in North Australia, the latter being characterised by an extraordinary regularity. A barometric curve plotted for several years for Port Darwin shows some very regular series of waves, from which it appears that the time which elapses from minimum to maximum is one year, from maximum to minimum two years, the period being exactly three years. These regular periods are particularly adapted to forecast air-pressure a considerable time in advance. On the principle upon which the scheme has been based it is claimed that it would have been possible to forecast the sign of the rainfall departure in Java for many of the years dealt with in the investigation. Attention is directed to the fact that in the Port Darwin curve the epoch of the maximum and minimum seems to be entirely controlled by the terrestrial seasons; cosmical influences, instead of causing barometric oscillations, seem to disturb them (namely during the sun-spot maximum).

The Journal of the Institution of Electrical Engineers for December 15 contains an extremely interesting paper by Mr. S. Evershed on the characteristics of insulation resistance. Mr. Evershed, as the result of a long course of experimental research, has come to the conclusion that the conductance through insulators of the "absorbent" class, such as impregnated paper, fibre, or cloth, is entirely due to the moisture which they contain. Curves are given to show that the insulation resistance falls as the voltage increases—or, as Mr. Evershed puts it, does not follow Ohm's law. If, on the other hand, the material is either perfectly dry or absolutely sodden with moisture, the insulation is the same within wide limits of potential difference. Another interesting fact ascertained is that the conductance through an insulator containing a certain quantity of water is far less than the conductance through the same quantity and thickness of water. To account for this, Mr. Evershed puts forward the hypothesis, supported by an experimental "model," that the moisture is distributed unequally in the dielectric—that there are a number of "blind alleys," and, in fact, only a very small proportion of the absorbed water is utilised in forming the leakage paths. In the discussion, Prof. A. Schwartz suggested that the distribution of the moisture in the dielectric followed a similar law to the distribution of sap in plants.

"Let Us Have Our Calculus Early." Such is the title of an article in the Bulletin of the American Mathematical Society for October by Prof. E. B. Wilson, written professedly as a review of Mr. J. W. Mercer's recent "Calculus for Beginners." Writing of the great decline which has taken place in the sway of mathematics over collegiate education, Prof. Wilson points out that this has occurred at a time when the need of mathematical knowledge in all branches of science and technology is greater than it ever was in the past. "One of the main troubles with us is that we do not select the right subjects to teach in the early collegiate years. There is no sense in giving the freshman a considerable course in advanced algebra. The subject is abstract, and deals with topics and ideas relatively unimportant for the student. Yet advanced algebra is often taught as a pre-requisite to calculus. It is unfortunate to force the freshman through an extended course in analytic geometry." This latter reference makes one wonder what Prof. Wilson would think of our recent epidemic of "projective geometries," good, bad, and indifferent, which may teach pupils to copy out proofs of stereotyped bookwork like Pascal's or Brianchon's theorems, but will never enable them to attempt a problem in mechanics involving a conic, cycloid, or catenary except by writing down the equation of the curve and becoming involved in hopelessly intractable formulæ from which the answer "may be obtained"—perhaps by the examiner, but with little credit and no educational value to the candidate.

In connection with the recent International Congress of Refrigeration held at Chicago and Washington, the Smithsonian Institution has directed attention to the first U.S. patent for the manufacture of ice, granted on May 6, 1851, to John Gorrie, of New Orleans, and now on exhibition in the U.S. National Museum. The patent fully describes the method of compressing air to a small part of its bulk, abstracting the heat liberated by a jet of water, allowing the air to re-expand in an engine, whereby the expansion is utilised and helps in the working of the condensing pump, injecting an uncongealable liquid into the engine, and circulating it as a medium to absorb heat from the water being frozen, and to give it out to the expanded air. "The employment of the engine for the purpose of rendering the expansion of the condensed air gradual, in order to obtain its full refrigeratory effects, and, at the same time, render available the mechanical force with which it tends to dilate to aid in working the condensing pump, irrespective of the manner in which the several parts are made, arranged, and operated" is a remarkably accurate description of the method for the time. Short of the actual recognition of the equivalence of work and heat, due to Mayer in 1844, the inventor's ideas could scarcely have been clearer. Gorrie published in 1844 several articles on the subject in *The Commercial Advertiser* of Apalachicola, Fla., a re-examination of which might be of interest from the point of view of the history of the dynamical theory of heat and the law of the conservation of energy. These papers, together with the original of the patent, have been deposited in the U.S. National Museum.

Part vi. of vol. xxi. of the Memoirs of the Indian Meteorological Department contains a discussion by Dr. G. C. Simpson of the potential gradient of atmospheric electricity at Simla. The data were derived from a Benndorf electrograph between May, 1907, and May, 1910, with an interruption between October and November, 1908, when the site of the instrument was altered. There are two tables showing respectively the annual variation of the potential gradient, and its diurnal variation for the twelve months of the year, for four quarters and for the year as a whole. Two plates show the results graphically. Use is made only of the days free from large irregular disturbances, numbering altogether 440. Owing to the non-existence of any sufficiently extensive level ground in Simla, it was impossible to deduce absolute values appropriate to a site in the open. The unit employed is thus an arbitrary one. The most remarkable feature is the frequent occurrence of negative potential in fine weather during May and June. This Dr. Simpson attributes to the presence of large quantities of dust in the atmosphere during the warm, dry weather which precedes the setting in of the monsoon. The number of days available, especially in July and August, is scarcely sufficient to give smooth diurnal inequalities for the individual months of the year; but there are obviously as a rule two maxima and two minima, one pair in the forenoon, the other in the afternoon. The morning minimum is usually the principal one, especially towards mid-winter, but in April, May, and June—especially June the minimum in the early afternoon is the more prominent. On the average of the years included, February gave the highest and June the lowest mean value of the potential.

A new method of preparing aqueous colloidal solutions of metals is described by H. Morris-Airey and J. H. Long in the Proceedings of the University of Durham Scientific Society (vol. v., part ii., pp. 68 and 113), which is based on the use of high-frequency alternating currents passing between electrodes of the metal immersed in water. It is possible to vary the range of frequency of the current between very wide limits, and in this way it has been shown that the colour supposed to be characteristic of the colloidal solutions of metals is a result of the special conditions of the discharge. Thus gold, for instance, on altering the frequency, can be made to give a red, blue, or purple solution; in the red solution the particles are negatively charged, and in the blue solution positively charged. The purple solutions contain both kinds of particles. The red solution is converted into the blue by the action of an electrolyte or electric field.

We learn from *Engineering* for December 26 that Prof. G. Benoit and Mr. Woernle are engaged on an investigation of the strength and durability of wire ropes. The research, which they are conducting in the laboratory for hoisting-machinery of the Technical High School at Karlsruhe, will occupy them for some time, but as the experiments are fairly conclusive regarding the deleterious influences of twisting, the preliminary results have been published. Twisted ropes have been proved by these experiments to be much less safe than the untwisted wires, even if the wires be annealed, thus demonstrating that the twisting leaves considerable strains in wire ropes, and especially on those made of high-class steels, which are chiefly used in mine haulage and winding. The method of experimenting consisted in applying the wires and ropes to a pulley which was turned to and fro through an angle of about 90° at the rate of 1000 turns per hour, thus bending and unbending the wires always in the same direction. Further experiments with alternating bending to different radii, &c., are now being made.

THE report of the Clifton College Scientific Society for the year 1912–13 has been received. It contains information of the work done during the session by the various sections among which the work of the society is divided. We notice among the contents an interesting calendar of bird observations made near Clifton, from January to July, 1913, to which a note is appended, stating that the Royal Agricultural Show enclosures on Clifton Downs greatly interfered with birds and observers during the season.

WE have received from the Carnegie Institution of Washington two volumes prepared under the auspices of the department of historical research. One, by Mr. David W. Parker, is a "Guide to the Materials for United States History in Canadian Archives"; the other, by Prof. Herbert E. Bolton, is a similar guide concerned with materials for the same purpose in the principal archives of Mexico. Both volumes belong to a series, to which we have directed attention on previous occasions, representing a systematic endeavour by the department of historical research to make more easily available for authors and students the materials contained in foreign archives necessary in studying the history of the United States. Volumes have appeared already dealing with Cuba, Spain, Great Britain, Italy, and Germany, and others concerned with the archives of Paris, Switzerland, the Netherlands, and Sweden are in course of preparation.

OUR ASTRONOMICAL COLUMN.

COMET 1913*f* (DELAVAN).—Prof. H. Kobold communicates, in a Kiel Circular, No. 144, dated December 21, the elements and ephemeris of Delavan's comet (1913*f*), the former being based on observations made on December 17, 18, and 19. The elements are as follows:—

Elements.

$T = .914$ March 2·3211 M.T. Berlin.
$\Omega = 126°\ 32'·6$
$\omega = 7\ 40·1$
$i = 13\ \ 4·6$
$\log q = 0·04526$

Ephemeris for 12h. M.T. Berlin.

	R.A. h. m. s.		Decl. ° ′		Mag.
Dec. 31	2 54 5	...	−5 18·4		
Jan. 1	53 44	...	5 4·9		
2	53 28	...	4 50·8		
3	53 12	...	4 36·1		
4	53 1	...	−4 20·9	...	10·5

A note in *The Times* of December 24 states that the comet will approach the earth and sun for the next two months, and while its brightness will be considerably increased, the object is not expected to be visible to the naked eye. Its south declination will be maintained until about the middle of January. The positions of the comet are in the constellations of Eridanus and Cetus.

AN AID TO TRANSIT CIRCLE OBSERVERS.—Transit observers are only too well aware of the time occupied in reading off chronograph strips, the work involved, even when assisted by a writer, being equal to that of making the observations themselves. Any suggestion of a method of reducing the labour will be welcomed provided it can be thoroughly relied upon. Prof. E. Grossmann, in *Astronomische Nachrichten*, No. 4701, describes a very practical arrangement which seems very efficient and simple. He adopts the reading apparatus constructed by Th. von Oppolzer, and works this in conjunction with an ordinary typewriter. All the observer has to do is to place the movable thread on the observed signal on the tape and the press of a key is sufficient to write automatically the scale reading underneath. In the paper Prof. Grossmann describes the apparatus in some detail, and accompanies the text with two illustrations. Messrs. Favargar and Co. in Neuchatel were entrusted with the arranging of the complete apparatus.

STANDARD WAVE-LENGTH DETERMINATIONS. No. 75 of the Contributions from the Mount Wilson Solar Observatory is devoted to the second paper by Messrs. St. John and L. W. Ware, entitled "Tertiary Standards with the Plane Grating: the Testing and Selection of Standards." In this paper the authors have examined the international secondary standards from λ4282 to λ5506 as to their consistency among themselves, and have determined the wave-lengths in international units of a series of 198 lines in the arc spectrum of iron from λ4118 to λ5506. The region from λ5371 to λ5506 is common to the 1912 and 1913 investigations, but an entirely new series of plates was made for the common region. The Pasadena plates were taken with the 30-ft. spectrograph, while the Mount Wilson plates were secured with the 75-ft. Littrow spectroscope used in conjunction with the 150-ft. tower telescope. The communication, which is published in considerable detail, is another example of the high accuracy attained in the Mount Wilson determinations. It is interesting to note that the difference between the heights above sea-level of Pasadena (244 m.) and Mount Wilson (1794 m.) is responsible for changes in relative wave-length determinations at the two stations. Numerous important conclusions are summed up at the end of the paper.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES FOR 1913.

Geometry.—The Francœur prize to A. Claude, for the whole of his astronomical work; the Bordin prize was not awarded, no memoir on the question proposed having been received.

Mechanics.—The Montyon prize to M. Sauvage; the Poncelet prize to Maurice Leblanc, for his work in mechanics.

Navigation. The extraordinary prize for the Navy is divided between Le Prieur (1800 francs), Geynet (1800 francs), Violette (1800 francs), and R. E. Godfroy (600 francs); the Plumey prize to M. Risbec, for his work on the propulsion and stability of ships.

Astronomy.—The Pierre Guzman prize is not awarded; the Lalande prize to J. Bosler, for his researches on the sudden variations of terrestrial magnetism and their connection with disturbances in the sun; the Valz prize to Prof. Fowler, for his researches in spectroscopy; the G. de Pontecoulant prize to M. Sundmann, for his researches on the problem of three bodies.

Geography.—The Tchihatchef prize to Col. Peter Kusmitch Kozlov, for his explorations and publications on Central Asia; the Gay prize to Dr. Mocquart, for his memoirs on tropical reptiles.

Physics.—The Hébert prize to Prof. Swingedauw, for his researches on explosive potential and electrotechnics; the Hughes prize to Jean Becquerel, for his work in magneto-optics; the De Parville prize to Prof. Rothé, for the whole of his researches in physics; the Gaston Planté prize to R. V. Picou, for his work in the field of electrical industry; the Kastner-Boursalt prize to Benjamin Chauveau, for his researches in atmospheric electricity.

Chemistry.—The Jecker prize is divided between Eug. Léger (3000 francs), for his work on vegetable alkaloids, M. Mailhe (2500 francs), for his researches on catalytic reduction, Amand Valeur (2500 francs), for his work in analytical, organic, and thermochemistry, and Fernand Bodroux (2000 francs), for work in organic chemistry; the Cahours prize divided between Mme. Ramart-Lucas Paul Clausmann, and E. Chablay; the Montyon prize (unhealthy trades) to MM. Desgrez and Balthazard (2500 francs), for their work relating to life in a confined atmosphere, M. Henriet receiving a mention (1500 francs), for his memoir on the impurities of Paris air; the Berthelot prize to Ernest Fourneau, for his syntheses of stovaine, novocaine, and other substances of service in therapeutics; the Vaillant prize was not awarded, as no memoir was received dealing with the question proposed.

Mineralogy and Geology.—The Delesse prize to Robert Douvillé, for his important works relating to certain groups of ammonites in France and South America; the Joseph Labbé prize to M. Dussert, for two memoirs dealing with the metalliferous deposits of Algeria; the Victor Raulin prize to J. Blayac, for his paper dealing with the geology of the Seybouse and some neighbouring regions.

Botany.—The Desmazières prize to M. Hariot, for his work on marine flora; the Montagne prize to M. Gain, naturalist on the *Pourquoi-Pas?*, for his memoir on the Algæ of the Antarctic regions; the de Coincy prize to Marcel Dubard, for his researches on the Sapotaceæ; the Grand prize of the physical sciences to Auguste Chevalier, for his geographical study of the flora of western French Africa; the Thore prize to Etienne Foëx, for his publications on the Erysibaceæ; the de la Fons-Melicocq prize to Eugène Coquidé, for his study of the vegetation of the peaty valleys of Picardy.

Rural Economy.—The Bigot de Morogues prize to Gustave André for his work on agricultural chemistry and the chemistry of the soil.

Zoology.—The Savigny prize to Henri Neuville, for his work on the invertebrates of Abyssinia; the Cuvier prize to Charles Oberthür for his studies in entomology and comparative lepidopterology.

Medicine and Surgery.—Montyon prizes (2500 francs each), to Mme. Lina Negri Luzzani, for her studies on the corpuscles discovered in the nervous system of rabid animals, to L. Ambard, for his memoir on renal secretion, and to MM. A. Raillet, G. Moussu, and A. Henry, for their researches on the etiology, prophylaxy and treatment of distomatosis in ruminants. Mentions of 1500 francs each are accorded to M. Marquis, for his memoir on mercuric chloride in surgery, to M. Legrange, for his work on the treatment of chronic glaucoma; and to Fernand Bezançon and S. L. de Jong, for their treatise on the examination of sputa. Citations are given to Henri Paillard, for his works on pleurisy, Paul Hallopeau, for his memoir on temporary disarticulation in the treatment of tuberculosis of the foot, and A. Sartory and Marc Langlais, for their work entitled dust and micro-organisms of the air. The Barbier prize is divided between Jules and André Boeckel and MM. de Beurmann and Gougerot; prizes of 2000 francs each are awarded from the Bréant funds to C. Levaditi, for works on epidemic acute poliomyelitis, A. Netter and R. Debré, for their memoir on cerebrospinal meningitis, and V. Babès for his treatise on hydrophobia; the Godard prize to J. Tanton; the Baron Larrey prize to A. Dejouany; the Bellion prize to Albert Frouin and Pierre Gérard, for their study of the rôle of mineral salts in digestion; the Argut prize to Claudius Regaud and Robert Crémieux, for their study of the effects of X-rays on the thymoid and the treatment of hypertrophy of this gland by Röntgentherapy; the Mège prize was not awarded.

Physiology.—A Montyon prize (experimental physiology) to Michel Cohendy, for his work on life without micro-organisms; the Philipeaux prize to Louis Lapicque, for his researches on the electric stimulation of nerves, an honourable mention to Samson Levin; the Lallemand prize is not awarded, but A. Barré receives a very honourable mention; the Pourat prize to Th. Nogier and Cl. Regaud, for researches on the comparative action of filtered and unfiltered X-rays on living tissues.

Statistics.—Montyon prizes to Henri Bresson (1000 francs), Albert Quiquet (1000 francs), and M. Thollon (500 francs).

History of Science.—The Binoux prize to M. Molk, for the French edition of the "Encyclopédie des Sciences mathematiques."

General Prizes.—The Lavoisier medal to Ernest Solvay; Berthelot medals to MM. Léger, Fourneau, Desgrez, and Balthazard; the Henri Becquerel prize to Louis Dunoyer, for his researches in physics; the Gegner prize to J. H. Fabre; the Launelongue prize divided between Mme. Cuseo and Mme. Ruck; the Gustave Roux prize to M. Montel, for his work on the theory of analytical functions; the Trémont prize to Charles Frémont; the interest on the Leconte prize (2500 francs) to S. Bivort, for the construction of a shorthand machine for the use of the blind; the Wilde prize (4000 francs) to M. Borrelly, for his astronomical discoveries; the Lonchampt prize is divided between Emile Demoussy (3000 francs), for his physico-chemical researches in plant physiology, and M. Agulhon (1000 francs), for his work on the function of boron in living matter; the Saintour prize is divided between Camille Tissot (2000 francs), for his work on wireless telegraphy, and M. Maire, for his studies in the history of science; the Henri de Parville prize to Jean Perrin; the Fanny Emden prize is not awarded, but encouragements are given to Guillaume de Fontenay (2000 francs), and J. Courtier (1000 francs); the d'Ormoy prize to Claude Guichard, for the whole of his mathematical works; the Petit d'Ormoy prize to Jules Lefèvre, for the whole of his scientific work; the Pierson-Perrin prize is divided between Ch. Fabry (2000 francs), H. Buisson (2000 francs), and Rodolphe Soreau (1000 francs); the Parkin prize is not awarded; the Estrade-Delcros prize to Mme. Charles André; the Danton prize to Eugène and Léon Bloch; the prize founded by Mme. la Marquise de Laplace to M. Boutteville; the prize founded by Félix Rivot between MM. Demay, Perrin, Boutteville, and Renaud.

The Bonaparte Fund.

The committee appointed by the Paris Academy of Sciences to allocate the grants from this fund for the year 1913 have made the following proposals:—Out of sixty-three applications the committee recommend twenty-one grants.

3000 francs to H. Caillol, for the publication of his catalogue of the Coleoptera of Provence.

2000 francs to A. Colson, for apparatus required for his work in physical chemistry.

2000 francs to E. Coquidé, to assist him in his study of the means of utilising peaty soil.

2000 francs to C. Schlegel, for the continuation of his researches in the laboratory of M. Delage.

6000 francs, in equal parts, between MM. Pitard and Pallary, for assistance in the continuation of their scientific work in Morocco.

2000 francs to Jules Welsch, for his geological work on the coasts of western France and Great Britain.

2000 francs to Louis Roule, for continuing and extending his researches on the morphology and biology of the salmon in France.

2000 francs to Jean Pougnet, for the continuation of his researches on the chemical and biological action of ultra-violet light.

2000 francs to C. Dauzère for his work on cellular vortices.

2000 francs to Méd. Gard, for the publication of a work and atlas on material left by the late M. Bornet.

4000 francs to Aug. Chevalier, to meet the expense necessitated by the classification of the botanical material arising from his expeditions in Africa.

2000 francs to Paul Becquerel, for the continuation of his physiological researches relating to the influence of radio-active substances upon the nutrition, reproduction, and variation of some species of plants.

4000 francs to Le Morvan, for assistance in publishing the photographic atlas of the moon.

2000 francs to Jacques Pellegrin, to assist him to pursue his researches and publish works on African fishes.

3000 francs to E. Rengade, for a systematic research on the presence and distribution of the rare alkali metals in mineral waters.

3000 francs to Charles Alluaud, for the publication of work on the Alpine fauna and flora of the high mountainous regions of eastern Africa.

2000 francs to Charles Lormand, for the purchase of a sufficient quantity of radium bromide to carry out methodical researches on the action of radio-activity on the development of plants.

2000 francs to Alphonse Labbé, for researches on the modifications undergone by animals on changing from salt to fresh water or the reverse.

3000 francs to G. de Gironcourt, for the publication of the scientific results of his expeditions in Morocco and western Africa.

3000 francs to A. F. Legendre, for the publication of maps and documents of his expeditions in China.

2000 francs to H. Abraham, for the determination of the velocity of propagation of Hertzian waves between Paris and Toulon.

PAPERS ON VERTEBRATE PALÆONTOLOGY.

TO vol. xxii. (pp. 407–420) of the Bulletin of the American Museum of Natural History Prof. H. F. Osborn contributes two articles on the skulls of ungulates from the Wind River Lower Eocene of Wyoming. A very interesting point is that in the members of the family Uintatheriidæ chacteristic of this stage, such as Bathyopsis, the skull lacks the great bony horn-cores of the later types, their place being taken by small knobs. In the perissodactyle Titanotheriidæ it has been found that two phyla of the genus Eotitanops are recognisable, one comprising relatively small, persistently primitive light-limbed species, and the other animals of a larger and more progressive type. Several new species are named.

In the Bulletin of the Department of Geology, California University (vol. vii., pp. 169–175), Dr. J. C. Merriam describes a lower molar of a tapir obtained many years ago from the auriferous gravels of California as a new race of a species described by Leidy from the Pleistocene of South Carolina To this race (*Tapirus haysii californicus*) is provisionally referred a set of three upper molars from the late Tertiary of Oregon. The species appears to be nearly related to the existing Central American *T. bairdi.*

The skeletons of *Saurolophus osborni*, a duck-billed dinosaur of the family Trachodontidæ, and of *Hypacrosaurus altispinus*, a new genus and species of the same family, both from the Upper Cretaceous of Edmonton, Alberta, Canada, form the subject of two papers by Mr. Barnum Brown in vol. xxxii. (pp. 387–407) of the Bulletin of the American Museum of Natural History. The type skeleton of the former, which measures about 32 ft. in length—the same as that of the contemporaneous *Trachodon mirabilis*—has been mounted on a slab for exhibition. Saurolophus, it appears, is much more numerously represented in the Edmonton beds than its cousin Trachodon. Hypacrosaurus is characterised by the great height of the spines of the dorsal vertebræ, coupled with the presence of nine vertebræ in the sacrum, against eight in the allied genus.

Under the name of *Rutiodon manhattensis*, Prof. F. von Huene describes in the volume last cited (pp. 275–283) the remains of a new species of phytosaur (belodont) from the Upper Triassic of Fort Lee, New Jersey, at the base of the "Palisades," opposite New York. In the opinion of the describer, Rutiodon and the European Mystrisuchus, on account of the taller spines of their vertebræ and the consequently more compressed form of their bodies, were probably better swimmers than the typical Phytosaurus. Both were long-snouted reptiles, of larger bodily size than Phytosaurus, the new species being the biggest yet described.

From the Trias of Heligoland Mr. H. Schroeder (*K. Preuss. Geol. Landesanstalt*) describes a beautifully preserved skull of a large stegocephalian (labyrinthodont) as a new species (*C. helgolandiae*) of the genus typified by von Meyer's *Capitosaurus nasutus* from the Trias of Burnberg.

Mere reference will suffice for supplementary notes on fossil sharks by Messrs. D. S. Jordan and C. H. Beal, published in the Bulletin of the Department of Geology, California University (vol. vii., pp. 243–256).

In the Bulletin of the American Museum of Natural History, vol. xxxii., pp. 437–439, Dr. R. Broom records additional remains of the extinct South African horse described by himself in 1909 under the name of *Equus capensis*. These are stated to indicate a heavily built, short-legged species, standing about fourteen hands, and apparently distinct from all the existing South African members of the genus, as well as from the Arab stock.

In a second communication the same author (*op. cit.*, pp. 441–437) describes a number of remains of South African dicynodont reptiles, many of which are regarded as representing new species of the typical Dicynodon, while others are assigned to new genera. It is interesting to note that a skull described by Huxley as that of a lizard, under the name of *Pristerodon mackayi*, really represents a dicynodont furnished with cheek-teeth.

R. L.

AGRICULTURE AT THE BRITISH ASSOCIATION.

THE meeting this year was one of the most successful held since agriculture has been recognised at the British Association, both the quality of the papers and the attendance at the section being exceedingly good. Prof. Wood, in his presidential address, dealt with a problem which has now assumed very great importance. Hitherto the agricultural expert working in the counties and among farmers, has had to demonstrate certain facts which were already known at the experiment stations. One of the most important is the effect of phosphates in improving grassland, an effect so striking that it can be demonstrated without very refined experiments, so that the "single-plot method" serves the purpose very well. Another fact which had to be demonstrated and where the same method suffices is that in the case of most of the late-cropping varieties of potatoes the use of seed from certain districts in Scotland or the north of Ireland is profitable. But there are many cases where the somewhat crude single-plot method gives only indefinite results, and careful investigation has shown it to be incapable of revealing differences less than 10 or 15 per cent.; more refined methods are needed as soon as quantities of this order are to be dealt with. Prof. Wood went on to deal with some of these new methods and to urge their more general adoption in field work.

The address was followed by a paper by Prof. Fraser Story, Bangor, on methods of German forestry. The five principal trees occurring in the German forests are Scotch pine (45 per cent.), spruce (20 per cent.), beech (14 per cent.), oak (7 per cent.), and silver fir (3 per cent.) The commonest method of regenerating the pine forest is by planting one- or two-year-old seedlings, the scanty foliage of which resists drying in sandy soils better than larger plants. In the case of spruce, on the other hand, transplanting material is used because the tree is grown in hilly or mountainous districts where there is more precipitation and greater danger of suppression by weeds. Beech and silver fir require shade when young, and therefore natural regeneration is resorted to, so that they may receive the shelter they need from the parent trees. Oak is generally raised from the acorn sown by hand, usually in a sheltered wood.

Mr. Collinge followed with a description of a peculiar disease of cereals and roots and the action of sulphur and lime. The disease is known as "May-sick," and it is most evident on wheat. Mr. Collinge considered it is due to bacteria which interfere with the nutrition of the plant. Sulphur and unslaked lime are found to be successful remedies.

The growing of linseed as a farm crop was next discussed by Mr. Duncan Davidson. Experiments made in this country during the last three years show that the crop can be successfully grown, that 10 to 15 cwt. of linseed per acre can be obtained on medium land at a cost of about 6*l.*, while the present price of the same quantity of linseed meal is 10*l.* The climate both of England and Wales is found to be quite suitable for the crop, and any soil of good texture and depth and not likely to dry out is suitable. The best time for sowing seems to be from the middle of April to the middle of May, but the seed at present obtainable is quite unsuitable owing to its mixed origin, impure condition, and low vitality. There is also some difficulty about the thrashing; there is no market as yet for the straw.

Prof. Barker and Mr. Gimingham gave a further account of their work on the fungicidal action of Bordeaux mixture which they attribute to the solvent action exerted by the fungus cells on the insoluble compounds of the spray fluid. They found that germinated spores and the thin-walled cells of the fungus hyphæ exert a definite solvent action and are killed by the absorption of the dissolved copper. Similar results are obtained with root hairs and the roots of germinating seedlings. The cuticle of the upper epidermis of apple leaves, however, seems to be practically impermeable during spring and summer; at any rate, no injury follows spraying so long as the cuticle is unbroken. In autumn, however, the cuticle is more permeable and death results more easily.

The second day was devoted to a joint discussion with the Botanical Section on the problems of barley production. Mr. E. S. Beaven opened with a very good account of the experiments he has been carrying out for some years at Warminster on the selection of barley for productivity. In the case of cereal crops the produce of dry grain on unit area is the sum of the following factors:—(*a*) number of plants surviving on the area at harvest; (*b*) the average dry weight per plant, which is the sum of the average number of stems per plant and the average weight per stem; (*c*) the ratio of the dry matter of the seed to the dry matter of the plant. These factors have been very fully investigated by Mr. Beaven, and a considerable interest attaches to the third, which he calls the migration factor, and which relates to the rate of transfer of material from the stem, leaf, and root to the seed. Mr. Beaven finds that this factor is high in the good yielding varieties, and in good seasons, and he has got evidence that it is a definite character. It will be extremely interesting to follow up this migration factor and see in what way it is related to the other properties of the plant.

This paper was followed by three others dealing with Irish barley experiments. These were commenced in 1899 with the intention of improving the Irish barley crop. It was soon found that the varieties in common use were inferior to the best known elsewhere, and experiments were begun with other varieties, two of which turned out to be very useful, "Archer" and "Goldthorpe." "Archer" is a narrow-eared barley, not usually grown on heavy soils or in late districts, but on light soils and in early districts, the result of its natural tendency to ripen late. "Goldthorpe," on the other hand, is a typical wide-eared barley ripening about a week earlier than "Archer," and therefore more suitable on heavy land. Mr. Bennett showed that the strain of "Archer" raised in Ireland is just as good as that imported from elsewhere. By careful selection improvements have been effected, not only in cropping capacity, but also in quality.

Mr. Hunter described the continuation of these experiments and the method of selection now in use at Ballinacurra. For the past two years a large number of plots on a very small scale are set up, and consequently a number of pure lines can be investigated.

Dr. Hackett discussed the results from a statistical point of view.

Another joint discussion dealing with live-stock problems is reported in the account of the Physiological Section, and need not be further dealt with here (see Nature, December 18, 1913, p. 462).

"The Utilisation of Sewage in Agriculture" formed the subject of a paper by Dr. Grossmann. He attributed the unsatisfactory results obtained in farming with sewage sludge to the fatty matter invariably present, and described a process whereby the dry sludge is mixed with a small percentage of acid, and subjected to the action of superheated steam, which carries off the fatty matters, whereby an inodorous brown powder is obtained, containing on an average 1–5 per cent. of nitrogen, 3 per cent. of calcium phosphate, 0·5 per cent. of potash, and 30–40 per cent. of organic matter. It was stated that good results had been obtained by the use of this material as manure. The author considers that the process removes one of the great difficulties in dealing with sludge; hence the sewage engineer may now aim at producing more sludge than before.

A group of three papers on soil followed. Dr. Hutchinson described experiments made in conjunction with Mr. McLennan showing that a partial sterilisation effect, intermediate in character between that exercised by heat and mild antiseptics, could be brought about by treating soil with quicklime. In the cases presented somewhere about 1 per cent. of lime was necessary; after a certain incubation period the soil bacteria then began to multiply rapidly and yield large increases in the amount of ammonia and of nitrate.

This was followed by a paper by Mr. Goodey describing his investigations on the protozoa of the soil. The first forms investigated were the ciliated protozoa, particularly Colpoda. Evidence was adduced to show that this organism probably exists in the soil as cysts, though it must have had some active existence some time because of the large numbers in which cysts occur. Another investigation dealt with the effects of partial sterilisation on two old soils which had been stored in bottles for many years at Rothamsted, one since 1846 and the other since 1870. The 1870 soil behaves normally on partial sterilisation, giving an increase in bacterial numbers and also in ammonia and nitrate, showing that the limiting factor present in ordinary soils was also present in this soil; amœbæ and flagellates also occurred. The 1846 soil, however, behaved entirely differently and showed the phenomena of a soil already partially sterilised; there was no evidence of any limiting factor being present, and no amœbæ, flagellates, or other protozoa could be found.

In the discussion that followed Prof. Gamble expressed the opinion that amœbæ and flagellates could probably be found in an active condition in the soil although the ciliates probably were not.

A third paper dealt with the nitrification in some pasture soils, and was presented by Mr. Gimingham. It is known that nitrification is reduced to a minimum in pasture soils rendered acid by the continued use of ammonium salts as manure, and an investigation was therefore made of a soil intermediate in character between the true moor and the true fen soil. This contains 30 to 40 per cent. of organic matter and only traces of carbonate, but the water is neutral in action. The soil was found to be capable of bringing about rapid nitrification of peptone, a remarkable feature being the great amount of action directly the peptone was added. Ammonium sulphate also quickly nitrifies, but the soil in this case takes on a feebly acid reaction.

Prof. Bottomley described experiments in which peat was treated with certain aërobic soil bacteria, and then became converted into a blackish-looking powder of distinct manurial value. It was also stated that the substance conditioned fixation of nitrogen in the soil.

A paper was presented by Miss Taylor on the life-history of *Eriophyes ribis*. When *Ribis nigrum* is the host-plant the embryonic true leaves of the bud are attacked by the mite and the bud develops into a "big-bud." No injury is caused, however, to the foliage of the tree. The migration of mites from infested buds is carried out mainly by the wind. On the other hand, when *Ribis grossularia* is the host-plant the scales leaves of the bud only are attacked and no big-bud is formed. Apparently the mite cannot penetrate the true leaves of the bud, and injury is confined to the foliage. Distribution by wind is not general, migration being mainly due to the mite crawling from the infested bud to the expanding leaves.

Dr. Winifred Brenchley summarised her investigations on the weeds of arable land. On clay soils the weed flora is less rich in species than on light loam, and though several plants have a distinct preference for heavy land no species can be said to be symptomatic of clay, occurring on such soils and nowhere else. Sandy soils possess a much more characteristic weed flora, as they are colonised by a great diversity of plants, a number of which are distinctly associated with light soils. Such plants as spurry, corn marigold, sheep's sorrel, and knawel appeared to be characteristic of sandy soils which are deficient in chalk; in other words, "sour" soils. Chalk provides a peculiar habitat for weeds, and the weed flora is very rich in species, some of which are markedly characteristic. There is evidence now that a distinct association exists between the species of weed and the soil in which they grow. This association may be local, when the weed is symptomatic of the soil in one district, but not exclusively associated with it in another. On the other hand, it may be general, when a certain species is symptomatic or characteristic of the same type of soil in different districts. The nature of the crop also plays a part in determining the weed flora.

A note was presented by Miss Armitage on the two varieties of corn spurry. *Spergula arvensis* is a rather frequent weed on the red sandy loam in Herefordshire, but the author never observed it in such development as to cause injury to crops. *Spergula sativa*, as she had seen it in Cheshire, is a terrible pest, causing marked injury both to roots and clover. It would be interesting to know whether this was always more harmful than *S. arvensis*.

The section concluded with a very interesting and important paper by Sir Richard Paget on the possibility of partnership between landlord and tenant. A form of agreement has been drawn up on this basis and was distributed at the meeting. An interesting discussion followed, which, however, is rather of general than of purely scientific interest.

PSYCHOLOGY AT THE BRITISH ASSOCIATION.

A SEPARATE Subsection of Psychology was formed this year at the British Association for the first time. The experiment was even more successful than had been anticipated. The general attendance was large and often crowded. Almost every experimental psychologist in Great Britain either attended the meetings or else sent or promised papers. The contributions received were so numerous that four meetings were held during afternoons.

The proceedings of the subsection opened on Thursday with a series of papers, for the most part philosophical in character. The first paper was one by Dr. Wildon Carr, upon "The Absurdity of Psychophysiological Parallelism even as a Hypothesis." Dr. Carr suggested that in considering the relation between body and mind, parallelism was not the only alternative to interaction; the relation might be solidarity of function, in which two independent realities are united. Mr. McDougall's paper upon laughter aroused especial interest. Taking the chief theories of laughter hitherto propounded, he claimed that they did not account for all varieties of laughter, and, further, that they did not even seek to answer the most fundamental problem, namely to what end did the human species acquire this capacity for laughing? The conditions exciting laughter he endeavoured to reduce to (1) situations that are mildly unpleasant, except so far as they are redeemed by laughter; (2) those things which would excite a feeble degree of sympathetic pain, if we did not actually laugh at them. The effects of laughter he described as consisting especially in an increase of the general and pleasurable sense of well-being. He added that the appearance of laughter seemed especially associated with the development of social life. From these considerations he argued that laughter proper (as distinguished from the smile, which in the adult has become secondarily associated with it) is a protective reaction which shields us from the depressing influence of the shortcomings of our fellow-men. Laughter, in short, is the antidote to sympathy.

In the afternoon Dr. Watt gave a careful exposition of "Some Main Principles of Integration." Prof. Carveth Read followed with an analysis of "The Conditions of Belief in Immature Minds." The chief relevant characteristic of the mind of the savage and the child, he pointed out, is the unusual influence of illogical inferences, or imaginations, and of non-evidentiary causes of belief. This characteristic depends upon (1) an unusual vividness of imagination; (2) an absence of exact knowledge as a standard; (3) an inability to make comparisons, either because of the influence of desires, or because of the imperfect development or education of the mind; the mind is consequently in a state of incoordination, and its beliefs form relatively isolated systems.

On Friday the subsection held a joint sitting with Section I (Physiology). In the morning Prof. R. M. Ogden (of Knoxville, Tennessee, U.S.A.) gave an account of "Some Experiments on the Localisation of Visual Images." The images were suggested by a series of fifty words. It was found that the images of memory tended to be located at their proper place and distance, while the images of imagination tended to be placed upon the disc fixated during the introspections.

Dr. Myers described "Experiments on Sound Localisation," carried out in the sound-proof room of the new psychological laboratory at Cambridge. The sound was usually a fundamental tone of 200 vibrations, accompanied by overtones separately emitted; these were led into the sound-proof room by a tube ending in a movable funnel carried by a noiseless perimeter. In the end, timbre and loudness proved the only trustworthy criteria whereby his subjects localised the sounds; laterality and medial incidence, exploited at first, were eventually abandoned. Alteration in the intensity of the several overtones, and in the loudness of the whole sound, increased very distinctly the number of erroneous localisations. In the case of a medial sound, just as in the case of a lateral sound, the spatial (and, sometimes, tactual) impressions seemed illusory. In reality they appeared to be of auditory origin. And in each case the spatial experience seemed to be a cue leading to a head movement, whereby the sound is more correctly localised.

Miss E. M. Smith described a series of observations, carried out in the same laboratory, upon "Habit Formation in Guinea-pigs." The tests used—(1) labyrinth test, (2) a new sensory test discrimination test—formed part of a larger scheme to test inheritability of learning, &c., and incidentally brought to light hitherto unrecorded points of interest concerning the behaviour of guinea-pigs. Miss May Smith reported results yielded by tests of Bergson's two forms of memory. The correlations tended to show that rote memory is distinct from pure memory (recognition) and more closely allied to physiological memory or habit. Dr. Shrubsall briefly discussed "The Relative Fertility and Morbidity of Defective and Normal Stocks." On examining the family histories of several thousand children, he found that the correlation between the size of the paternity and the number dead is much higher in defective stocks than in normal. In spite, therefore, of the notorious fertility of defective stocks, by adult age the disparity in size of family has, owing to higher morbidity, almost disappeared.

In the afternoon papers upon "Variations in the Spatial Threshold" and "A Simple Method of Demonstrating Weber's Law" were read by Mr. Godfrey Thomson and Mr. Shepherd Dawson respectively. Two important contributions to the study of fatigue were given by Miss May Smith and Mr. J. H. Winmis.

On Monday a joint meeting was held with Section L (Education). The morning was chiefly occupied with a discussion of spelling. A full report of the proceedings has appeared in the account of the work of the Education Section (December 25, 1913, p. 491).

The appeal of Dr. Kimmins (chief inspector, L.C.C.) for educational research may be mentioned as of special interest and importance. In the afternoon Mr. Valentine gave a paper on the phonic method of teaching reading, Mr. E. D. Lewis upon analytic and synthetic methods in learning, and Mr. Burt upon the mental differences between the sexes.

On Tuesday the greater part of the morning was occupied with papers on tests of intelligence. Dr. McIntyre and Miss Rogers described "The Application of the Binet-Simon Scale to Scots Children," and Mr. Moore and Mr. Winch described some "Tests of Reasoning" carried out at Liverpool and London. Mr. Fox recounted a series of experiments upon "The Conditions which arouse Mental Imagery in Thought." Imagery, it was found, appeared to arise chiefly when thought was momentarily hindered or obstructed.

In the afternoon the president of the Economics Section (Rev. P. H. Wicksteed) appealed for a study of "The Psychological Basis of Economics." Mr. Pear followed with an "Analysis of Some Personal Dreams," and Dr. Brown with a discussion of "Psycho-analysis." Dealing with the psychological doctrines of the school of Freud, the afternoon's discussion perhaps aroused a more general interest than any other.

On Wednesday morning the chief feature was a couple of papers by Mr. Pear and Mr. Wyatt upon testimony. Mr. Pear described the chief "Modern Experimental Investigations of Testimony," and emphasised their legal significance. Mr. Wyatt described experiments upon normal and defective school children in Manchester and Liverpool. He found that normal children, when uninfluenced by cross-examination and the personality of the questioner, can give testimony of a high degree of accuracy, but of small range; the testimony of defective children differs in quality more than in degree, but the difference is not very abrupt.

The chief impression created by the meetings of the subsection was a sense of the great and varied activity now going on in the various psychological laboratories recently established throughout the country, and the eagerness of the public and of the Press to recognise the "new" science and to emphasise (often to over-emphasise) its possibilities of development. The interest in practical applications was marked. But it was equally clear that the applications already attempted themselves pointed to the urgent need of further work the character of which shall be more purely scientific.

Cyril Burt.

ON THE HIGHEST UNIVERSITY EDUCATION IN GERMANY AND FRANCE.[1]

In the beginning of the nineteenth century Napoleon crushed the spirit and power of the Germans for a time, but the nation soon recovered from the blow through the stirring appeals which their great men, many of them professors in the universities, made to them, and their politicians and wise men, men of deep thought and strong will, deliberated earnestly in what way they could rescue their country from the depression under which it lay and restore it to independence and to a high place amongst the nations of the earth. They became convinced that one of the most effective means for this purpose was education, and

[1] From an address delivered at the University of St. Andrews on October 13, by Principal Sir James Donaldson.

they formed the following plan of carrying out this education. Their eyes were fixed on the young men of the country and they thought the best way to train them for civil and political life, and for the discharge of all the highest duties of statesmanship, was to divide their education into two periods. Thus arose the gymnasium and the present form of their universities. The idea of the gymnasium was that the boys should remain at school from eleven years of age until they were about twenty, under the strict discipline of the schoolmasters and be guided by them in all their studies. In these schools the young men were to be instructed in all the important knowledge which previous generations discovered and acquired. It was deemed that young men up to that age should not be invited to specialise. They were to be the recipients of the best ideas and methods which had come down to them through tradition.

The universities were to be the means of educating the young men from twenty to twenty-three, twenty-four, or twenty-five. It was at once seen that the method of education must be different. The experience which had been carried out successfully in the University of Halle gave the cue to the new work of the universities. This work assigned to the universities was to give a scientific education to all the young men who were fit to receive it. Science is the key-note of the system. There can be no good scientific training except on certain conditions. First of all the professors or teachers must themselves be men who pursue the scientific method of study and are advancing the boundaries of scientific knowledge. They must show in all their lectures the scientific spirit. Then there must be no restriction in the liberty to teach. Every man who is following the scientific method with adequate acquirements and capacity must be invited to teach; and, finally, the teacher must be untrammelled in his scientific investigations. He must search for truth solely for its own sake, and he must be allowed to express the conclusions to which he comes, whatever they may happen to be. This is what the legislators called Lehrfreiheit—the freedom of the instructor and the instruction. But along with these there must be Lernfreiheit—the freedom of learning and the learner. The learner must be free to choose the professors whose lectures he is to attend. There must be no restriction. The parents may advise him, but the State imposes no limitations. He goes where he has reason to believe that he will get what will stimulate him and guide him best. Of course, it was only those young men who had shown ability to whom a continuance of study would be profitable. They must be the best young men of the nation. Then these young men were no longer to be under the discipline of schoolmasters, but were to be free to choose for themselves how they were to study. No compulsion was to be used, but they were to select for themselves the teachers that would suit them, and the State was to supply them with all the best teachers or professors who could be found willing to teach and to lecture.

All this was done nearly 100 years ago. The plans of Humboldt and others were carried out consistently, and they now continue to the present day. The uniform opinion in Germany in regard to them is that the universities thus conducted have been of infinite benefit to the State, and have been along with the secondary schools a most important element in Germany's acquisition of extraordinary intellectual influence amidst the nations of the world, and in the building up of a great empire. I have adduced in proof of this in my previous addresses the testimony of eminent witnesses, such as Savigny, Stotzner, Max Müller, and I now adduce the opinion of Paulsen, the best authority on the subject. His little book, "The German Universities," is admirable, and deserves the attention of all who are interested in this subject. "Whoever understands youth," he says, "and knows the circumstances of German universities, will not doubt that all attempts to help along devotion to study by more or less mild expedients would be vain and harmful; vain, because only the semblance of such devotion, not the thing itself, can be forced; and harmful, because they weaken the sense of independence and responsibility. Forced study implies a scholastic system and scholastic relations between teacher and pupil, of the sort which existed in the mediæval universities. Such a condition is to-day inconceivable in the German universities." . . . "In the first place, the relations between student and instructor would be disturbed. At present these relations are throughout most satisfactory, resting as they do on a basis of freedom and mutual confidence, and every attempt to increase attendance on lectures by any other means than the attractiveness of the lectures would necessarily impair their charm. Who could endure to face a circle of hearers to whom he could not say at all times: 'Whoever thinks he does not find here what he wants, is under no compulsion to come'? Again, the student's attitude towards science herself would be altered. She, free herself, must be sought and loved by free men; if forced upon us, she would be detested by all—not only by those whose nature keeps them from intimacy with her, but by those also who now follow her of their own inclination.

"He who is not convinced of this from his knowledge of human nature may learn it from the experience of such measures gained everywhere and always."

No other universities for a long time adopted the methods of the German universities, but in recent times a considerable number of them made approaches without rigorously carrying out the ideal either of the gymnasium or the ideal of the university. In our own country we do a part of the higher work done at a German gymnasium at our universities, and for continuing this state of matters a powerful argument can be drawn from the circumstance that it is advisable that the passage of the boy from the strict discipline of the school to the unrestricted freedom of the university should be gradual and not too abrupt and difficult, as it is believed to be in Germany. In our universities also we have classes where the element of research is important; and so it is with some universities in England and America. But nowhere has there been the distinct difference between the education that treats the lad up to twenty as receptive and the young man of twenty and upwards as following out the desires of his own mind in the search for truth, responsible for his own development and free to do what he deems best for his intellectual and moral progress.

A remarkable start, however, has quite recently been made. From 1870, the French have been firmly convinced that one of the modes in which they can recover most effectively the position which they lost in the Franco-Prussian War is by devoting their attention to education at every stage, but most especially to the higher education. Gradually the French have come to believe that the German ideal is sound and their method of accomplishing it the best, and so they have now set it forth as that by which they are to work. This conviction was brought about by a slow process. It did not spring from a wish to imitate the Germans, but was borne in upon them by their own experience of university work. M. Liard, who has been the most prominent agent in creating the revolution in the French universities, has thus expressed these ideas:—"This sympathy and help has been found, this action has been forthcoming, and it is possible to-day to say that in spite of some remaining hesitation, inevitable so long as the revolution in progress is not finally carried out, the French universities are fully conscious of their three-fold function, or rather, of the three stages of their functions, in regard to learning. The first stage is to be a centre of general culture, the second to prepare for professions and careers, and, at the top, for picked students, to give opportunity for learned research. It is these ideas which have inspired the new regulations for examinations that have been submitted to the faculties. The best programme for a university is not to have one. The best regulations for professors is full liberty to teach, and for students full liberty to choose, at their own risk, out of the varied teaching of the university, according to their tastes, their aptitudes, and their plans for the future. In France, such a state of affairs is impossible, at least for many long years."

The difficulty, however, of attaining the highest aim in the French universities has not been found so great as might have been expected. In the first place, there has always been a considerable number of students in Paris continuing at their work until twenty-four or twenty-five or even longer, and, secondly, those who are now elected professors, are nearly all men who have devoted themselves to research, have gained the highest distinctions in their researches, and are therefore well able to inspire students with a love of scientific inquiry. It is fifteen years since M. Liard's paper was printed. During that time the University of Paris has made great efforts to carry out the ideal which he proposed, and there is no doubt that it has been strikingly successful.

Thus these two great nations have come to the conclusion that this is the best way to educate the men who are to have the highest influence in the State and the nation.

In Germany every professor has to deliver public lectures for which no fee is demanded. The French go beyond this, and many of their best professors deliver lectures suitable for the general student who may not wish a degree but simply a knowledge of the subject discussed, and, of course, they can also attend the classes which have been arranged for the qualified students. Now surely if this is the way in which two great nations believe that they can best educate their highly endowed citizens, is it not time that we should attempt something of the same kind? I have again and again said that there would be no great difficulty in accomplishing this in the University of St. Andrews. We have many students who are eager to continue their studies at the University. In fact, the great majority of those who have obtained the highest honours would gladly remain behind if their studies could have been so arranged as are the studies for the doctor of philosophy of Germany or the doctorat d'état of France, and in this way we could bring up some of our men to reach the highest excellence in the comprehension of the various problems which arise in the government of the people and in the amelioration of society. The same remarks could be made in regard to the other three Scottish universities.

But a very serious question emerges when we think not of Scotland alone, but of the British Empire. Are the universities of England and of the British Dominions to remain in a position unquestionably inferior to that of Germany and France? Is our Empire to fail in providing the culture requisite for the highest minds? Are we to take no means to supply the most perfect training to those who are to exercise supreme influence on the mass of men in the nations under our sway—the teachers, the legislators, the governing officials, and the literary men who guide the Press? Surely something is far wrong, if we do not at once look into this matter with the view of establishing at least an equality with Germany and France.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A memorial fund raised by the friends of the late Humphrey Owen Jones, F.R.S., fellow of Clare College, who, with his wife, was killed in the Alps in August, 1912, has been gratefully accepted by the University, and a Humphrey Owen Jones lectureship in physical chemistry has been established. The General Board of Studies will shortly proceed to appoint a lecturer. The stipend arising from the memorial fund is about 150*l*. Candidates are requested to send their applications to the registrary of the University on or before January 17.

IN connection with the development of the forestry department in the University of Edinburgh, a second lectureship has been founded, and Mr. J. Lyford-Pike has been promoted to the post.

A COURSE of five advanced lectures on generating stations will be given by Mr. W H. Patchell, at the Battersea Polytechnic, London, S.W., on Mondays, at 7.30, beginning on January 19. Admission to the lectures is free, and no ticket is required.

THE council of the Society of Engineers (Incorporated) may award in 1914 a premium of books or instruments to the value of 10*l*. 10*s*. for an approved essay on "The Status of the Engineering Profession." The competition is open to all, but, before entering, application for detailed particulars should be made to the secretary, 17 Victoria Street, Westminster. The last date for receiving essays is May 30, 1914.

COURSES of lectures in science and in literary subjects will be given in the University of Leeds on Tuesday, Wednesday, and Thursday, January 13–15. These lectures are intended primarily to meet the needs of teachers who find it difficult during the school term to keep in close touch with the most recent developments of thought in regard to their subjects. The courses will, however, be open not only to teachers, but to all students, whether former members of the University or not. Among the subjects of the courses are:—"The Rôle of Enzymes in Plant Metabolism," Prof. J. H. Priestley; and (1) "Artificial Parthenogenesis," (2) "Regeneration in Animals," W. O. Redman King.

THE Bulletin of the Massachusetts Institute of Technology, Boston, for December, 1913, contains a catalogue of the officers and students of the institute, a statement of the requirements for admission, and a description of the courses of instruction. In the account given of the facilities for research particulars are included of the Hawaiin Volcano Observatory. A gift to the institute in 1909 made provision for special research in seismology and other branches of geophysics. On January 1, 1912, the Hawaiin Volcano Research Association cooperated with the institute to establish an observatory and laboratory at the volcano Kilauea. Investigations are carried on by a resident staff, and properly qualified investigators are received at the observatory for special studies. A limited number of advanced students engaged in research dealing with the problems of volcanology and seismology are received also, and the work is described as specially suitable to candidates for the doctorate. Among topics suggested as thesis subjects we notice the spectroscopic study of volcanic flames, collection and analyses of volcanic gases, and optical pyrometry applied to molten magma in the field.

At the Headmasters' Conference, held on December 23 and 24, at Reading School, Sir Alfred Ewing, director of naval education, gave an address on the scheme of special entry for public schoolboys into the Navy. This scheme of special entry was introduced last year at very short notice, and the number of candidates who came forward was probably not at all so great as may be expected in the future. The candidates numbered ninety-two, and forty-one were taken for the training. Sir Alfred Ewing said hitherto the naval tradition has been unbroken which has required that officers shall join the service at so early an age that they can owe little or nothing to public school training and influence. Now, for the first time in British history, the Navy has said to the public schools, "Send us of your finished product." He asked the cooperation of the headmasters because anything which affects the supply of officers for the Navy, whether the volume of the supply or its efficiency, is a matter of profound national concern. By the scheme of special entry public schoolboys may enter the service at the age of eighteen, and undergo a brief period of professional training for eighteen months, after which they become midshipmen. The qualification desired in naval cadets entered in this way is substantially a good general education not specifically classical, but an education in which, apart from the more humane elements, there is a considerable bias towards mathematics, physical science, and mechanics. The reason of the bias is that these subjects form so much of the professional knowledge which a naval officer has to possess, and so what is substantially the Woolwich entrance examination, without one or two features of the present examination, has been adopted. In taking the public school boy and giving him a brief professional training, it would be very hard to give all the practical mechanical knowledge which the naval officer ought to possess in so short a time, unless there was initially some foundation for such knowledge or at least some aptitude for practical mechanics on the part of the candidate. Therefore the Woolwich list of examination papers is supplemented by introducing a paper on very elementary engineering—a paper intended rather to test the aptitude than the training of the candidate. This is an attempt to attract those who have a special bent towards engineering. Other subjects discussed at the conference were the Teachers' Register and several points in connection with classical education.

SOCIETIES AND ACADEMIES.

London.

Royal Meteorlogical Society, December 17.—Mr. C. J. P. Cave, president, in the chair.—R. C. **Mossman** and Mr. C. **Salter**: The great rain storm at Doncaster, September 17, 1913. On that day during a period of disturbed weather, a very heavy and local fall of rain took place in the vicinity of Doncaster. The storm lasted fourteen hours, and in that time more than 4 in. of rain fell at six stations, of which four had more than 5 in. The small area embraced by the heavy rain is shown by the circumstance that more than 4 in. fell over only sixty-one square miles, while more than 0·50 in. fell over 2336 square miles. Over the latter area 47,330 million gallons of water were precipitated. No adequate explanation of the storm can be offered, and the phenomenon affords an opportunity for special investigation.—Dr. J. E. **Church**, jun.: Recent studies of snow in the United States. The author first gave a description of the snow sampler and weigher, which is an instrument he has designed for quickly measuring the depth and the water content of snow upon mountains. He then referred to some of the phases of the snow which were susceptible of solution by the aid instrument, and showed that the evolution of th leads directly to the practical problem of the r of mountains and forests to the conservation of sno This is of vital interest wherever irrigation is essenti to agriculture, as in the western portion of the United States and in Australia. It is also closely related to the problem of stream control.—C. E. P. **Brooks**: The meteorological conditions of an ice sheet and their bearing on the desiccation of the globe. As the re occupied by extensive ice-sheets at the present day, Antarctica and Greenland, are the centres of permanent high-pressure areas, with slight precipitation, the author infers that the regions occupied by similar ice-sheets in the glacial period were likewise occupied by permanent anticyclones. The maximum extent of glaciation occurred at about the same time in different regions of the globe, and also coincided with the maximum of the pluvial period, or period of greater rainfall than the present, in the unglaciated regions. But a general decrease in temperature should lead to a decrease, not an increase, in the amount of evaporation, and hence of precipitation. The explanation of the paradox lies in the different distribution of the precipitation.

Edinburgh.

Royal Society, December 4, 1913.—Prof. Hudson Beare, vice-president, in the chair.—Dr. W. N. **Shaw**: Principia atmospherica—a study of the circulation of the atmosphere. Section I. consisted of five axioms or laws of atmospheric motion, viz. the relation of motion to pressure, the computation of pressure and of the application of the gaseous laws, the law of convection, the law of the limit of convection, and the law of saturation. Section II. contained two lemmas or postulates regarding the relation between temperature and pressure in the stratosphere and in the troposphere, and the average horizontal circulation in the northern hemisphere. In Section III., which formed the bulk of the address, Dr. Shaw laid down for discussion six propositions, three of which had been already dealt with in a communication recently made to the Scottish Meteorological Society and published in the journal of the society for 1913. The remaining three were then considered in some detail, viz.: (1) the conditions necessary to maintain a steady atmospheric current; (5) the calculation of the distribution of pressure and temperature in the upper air from the observations of structure represented by soundings with a pilot balloon; (6) to account for the general circulation of the atmosphere in the northern hemisphere.—Sir William **Turner**: Observations on the auditory organ in the Cetacea. The paper was in two parts, in which were treated respectively the external auditory meatus and ear-wax, and the tympano-petrous bones. One of the specimens of ear-wax exhibited was about 20 in. long, and had been obtained from a blue whale near the South Shetland Islands. Sir William Turner also read a note upon a siliceous sponge of the order Hexactinellida, consisting of white delicate thread-like spicules collected into two tufts or bundles.

December 15.—Prof. James Geikie, F.R.S., president, in the chair.—Prof. C. R. **Marshall**: The pharmacological action of tetra-alkyl ammonium compounds—part ii., the action of tetra-ethyl-ammonium chloride; part iii., the action of methyl-ethyl-ammonium chlorides. Tetra-ethyl-ammonium chloride resembles tetra-methyl-ammonium chloride in inducing paralysis by an action on the myo-neural junctions. It needs, however, much larger doses. Unlike tetra-methyl-ammonium chloride, it has no action on vagal terminations, and it is difficult to produce with it temporary cessation of the respiration. Trimethyldimethyl-diethyl, and methyl-triethyl-ammonium les produce actions, speaking broadly, intermediate to those of tetra-methyl- and tetra-ethyl-ammonium chlorides. None of these compounds stimulate the vagus endings.—Miss Dorothy **Court**: Enzymatic peptolysis in germinating seeds. Parts i. and ii.—Prof. A. H. **Gibson**: The kinetic energy of viscous flow through a circular tube. In the experiments, which were arranged to test the theory, the upper end of the tube projected into the reservoir, and head loss at entrance to the tube was represented the expression $cv^2/2g$, where the factor c is unity for very thin-walled tubes, and 0·5 for thick-walled tubes. The experiments gave, for three cases, values of c varying from 0·54 to 0·71, and these could be represented with fair accuracy by the formula

$$c=1/(2-n^2),$$

where n is the ratio of the inner to the outer diameter.—L. N. G. **Ramsay**: Polychæta of the family Nereidæ collected by the Scottish National Antarctic Expedition. These worms are poorly represented in Antarctic and sub-Antarctic regions. One new species was found near the Falkland Islands.

PARIS.

Academy of Sciences, December 22, 1913.—M. P. Appell in the chair.—Remarks by the President on the proceedings of the fifth general meeting of Weights and Measures, held at Paris and at Sèvres, October 9–17.—G. **Humbert**: Indefinite binary quadratic forms.—Ch. **Lallemand**: Remarks on the second conference concerning the international map of the world on the scale of 1 : 1,000,000, held at Paris, December 10–17.—Arnaud de **Gramont**: The band spectrum of aluminium and its presence in the flame spectrum of certain minerals. The mineral was heated in an oxy-acetylene flame, giving a temperature well above the melting point of iridium. Metallic aluminium or its haloid salts give a mixed line and band spectrum, details being given. The spectrum is not given by the oxygen compounds of aluminium in the oxy-acetylene flame; but this generalisation does not seem to hold with all minerals, some giving the spectrum and others not.—M. Edmond **Perrier** was elected vice-president for the year 1914.—Ernest **Esclangon**: Observation of the Delavan comet made with the large equatorial of Bordeaux Observatory. Positions given for December 19, on which date the comet was of the 11th magnitude.—J. **Guillaume**: Observations of the Delavan comet (1913*f*) made with the *coudé* equatorial at the Observatory of Lyons. Position for December 19. Comet as a whole 11th magnitude, stellar nucleus 13th magnitude.—M. **Giacobini**: Observations of the same comet made at the Paris Observatory. Three positions determined, December 19 and 20. P. **Chofardet**: On the same. Observations at Besançon on December 19 and 20.—Emile **Belot**: The extension of a theorem of Faye with application to the mode of formation of the planetary system.—St. **Chevalier**: The effect of atmospheric dispersion on the diameter of photographed stars.—Georges **Darmois**: Algebraic curves of constant torsion.—M. **Tzitzéica**: Networks with equal invariants.—B. **Hostinsky**: Closed curves of constant torsion. A. **Chatelet**: Complex multiplication.—Ernest **Esclangon**: Mean quasi-periodic functions, deduced from a quasi-periodic function.—Kampé de **Fériet**: The development of a function in a series of ultra-spherical polynomials.—Kyrille **Popoff**: Fredholm's equations of the first species.—G. **Bouligand**: Correction to a note on the problem of Dirichlet presented to the meeting of December 8.—Jean **Chazy**: The singular points of the general integral of the problem on n bodies.—Th. de **Donder**: The movement of heat in a body opaque to heat.—J. M. **Crafts**: General comparison of vapour pressures. If T and T' are the boiling points of any substance under pressures P and P', T'' and T''' are the boiling points under the same pressures of a standard substance (naphthalene), and C is a constant, it is shown that the relation $T-T'=(T''-T''')C$ holds for numerous substances of very varied nature.—Pierre **Weiss**: The molecular field and a law of action inversely as the sixth power of the distance.—Paul **Sélényi**: The existence and observation of non-homogeneous spherical light waves.—G. **Sagnac**: The proof of the reality of the luminous æther by the experiment of the rotating interferograph.—M. de **Broglie**: The continuous photographic registration of the spectra of Röntgen rays. The spectrum of tungsten. The influence of thermal agitation.—F. **Bourrières**: The observation of the Brownian movement with linear magnification above 20,000. In this work the ordinary eyepiece of a microscope was replaced by another complete microscope. Under these conditions the Brownian movement proved to consist of a double motion; the first with an amplitude of the order of a micron, the other about 1/50 of this.—V. **Schaffers**: The law of currents producing glow discharge in cylindrical fields.—R. **Marcelin**: The expression of velocities of transformation of physico-chemical systems as a function of the affinity.—M. **Gompel** and Victor **Henri**: The absorption of ultraviolet light by alkaloids of the morphine group and by phenanthrene.—Maurice **Nicloux**: The laws of absorption of carbon monoxide by the blood. The hæmoglobin of the blood corpuscles, put in contact with mixtures of carbon monoxide and oxygen, combines with both gases in proportions defined by their partial pressures in the mixture and in accordance with the law of mass action.—F. **Bodroux**: Catalytic esterification in the wet way. The production of esters in presence of dilute mineral acids. The ordinary theories of esterification by mineral acids fail to explain the catalytic action of these acids in very dilute solutions at 100° C. The author suggests the possible formation of an addition compound of the organic and mineral acids as an explanation of the action.—Charles **Staehling**: A supposed separation of radium D from lead in active lead by means of Grignard's reaction. The author has repeated the work of Hofmann and Wolff, and has been unable to obtain the positive separation indicated by these authors. The results are absolutely negative, and it is concluded that it is impossible to separate radium D from lead in active lead by the tetraphenyl-lead method.—J. **Riban**: Concerning the action of carbonyl chloride upon phosphates and oxides. Remarks on a recent paper by Barlot and Chauvenet.—Gabriel **Bertrand** and H. **Agulhon**: A method for estimating extremely small quantities of boron in organic materials.—Amé **Pictet** and Maurice **Bouvier**: Vacuum tar. A chemical study of the tar obtained by the distillation of coal at 450° C. under reduced pressure (15 mm. to 18 mm.). After separating alcohols and unsaturated hydrocarbons, two naphthenes, $C_{10}H_{20}$ and $C_{11}H_{22}$, were isolated, identical with two hydrocarbons obtained by Mabery from Canadian petroleum.—M. **Lespieau**: True acetylene derivatives obtained from dipropargyl compounds.—E. E. **Blaise**: Syntheses by means of the organometallic zinc compounds. The preparation of the α-ketonic acids.—Marcel **Sommelet**: A method of synthesis of benzyl chloride and its homologues. A new general method is described based on the following reaction,

$$RH+ClCH_2.O.R'=R.CH_2.OR'+HCl,$$

which takes place at $-10°$ C. in carbon bisulphide or carbon tetrachloride solution in presence of $SnCl_4$.—

Paul Gaubert: Mixed liquid crystals.—Albert Michel Lévy: The effects of the granitic metamorphism in the carboniferous eruptive tufas in the neighbourhood of Mâcon.—Pereira de Sousa: Contribution to the petrographical study of the north of Angola.—Marcel Delassus: The influence of the size of seeds on the general development and anatomy of plants.—Raoul Combes: The conversion of an anthocyanic pigment extracted from red autumnal leaves to the yellow pigment contained in the green leaves of the same plant. The yellow pigment is obtained by oxidising the red pigment with hydrogen peroxide. The change in the colour of leaves in the autumn is due to a process of reduction.—L. Blaringhem and E. Miège: Studies on the straw of wheat.—Armand Viré: Experiments on the divining rod. A detailed account of the successful use of the divining rod.—R. Robinson: The physiological localisations of the encephalus contrasted with extensive destruction of this organ.—I. G. Garfounkel and J. Gautrelet: Contribution to the study of the action of colouring matters on the heart and blood pressure.—Emile Yung: The vertical distribution of plankton in the lake of Geneva.—A. Gruvel: The anchovy (*Engraulis encrassicholus*) on the western coast of Africa.—Ch. Gravier: The incubation of Mopsea and Rhopalonella from the Antarctic.—Adrien Lucet: The influence of agitation of the broth cultures on the development of *Bacillus anthracis* and some other micro-organisms.—Henri Coupin: Zinc and *Sterigmatocystis nigra*.—J. Wolff: The catalytic action of iron in the development of barley.—A. Fernbach and M. Schoen: Pyruvic acid a life product of yeast.—Emile Haug: The geology of the southern slopes of Sainte-Baune.—J. Blayac: Relations between the sands of the Landes and the terraces of the Garonne.—A. Bigot: The structure of the Bocain zone.—P. Idrac: The inequalities of the distribution of terrestrial magnetism.

BOOKS RECEIVED.

Letzte Gedanken. By H. Poincaré. Translated by Dr. K. Lichtenecker. Pp. vi+261. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 4.50 marks.

The Madras Presidency, with Mysore, Coorg, and the Associated States. By E. Thurston. Pp. xii+293. (Cambridge: University Press.) 3*s.* net.

Plant Life. By T. H. Russell. Pp. 71. (Birmingham: Cornish Bros., Ltd.) 2*s.* 6*d.* net.

Royal Horticultural Society. Four Essays, written by Students at Wisley, 1913. Pp. 72. (London: Royal Horticultural Society.)

The Story of Plant Life in the British Isles. By A. R. Horwood. Pp. xiv+254. (London: J. and A. Churchill.) 6*s.* 6*d.* net.

Water: Its Purification and Use in the Industries. By W. W. Christie. Pp. xi+219. (London: Constable and Co., Ltd.) 8*s.* 6*d.* net.

Transmission Line Formulas for Electrical Engineers and Engineering Students. By H. B. Dwight. Pp. vi+137. (London: Constable and Co., Ltd.) 8*s.* 6*d.* net.

DIARY OF SOCIETIES.

FRIDAY, JANUARY 2.

GEOLOGISTS' ASSOCIATION, at 8.—The North Sea Drift and Certain Brick-Earths in Suffolk: P. G. H. Boswell.

MONDAY, JANUARY 5.

ARISTOTELIAN SOCIETY, at 8.—Philosophy as Co-ordination of Science: H. S. Shelton.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Viscosity of Oils: J. L. Strevens.—The Oxygen Content of Gases from Roasting Pyrites: L. T. Wright.—The Electrical Conductivity of Milk During its Concentration, with Suggestions for a Practical Method of Determining the End Point in the Manufacture of Sweetened Condensed Milk: L. C. Jackson, L. McNah, and A. C. H. Rothera.—Monazite from Some New Localities: S. J. Johnstone.

RÖNTGEN SOCIETY, at 8.15.—Histological Changes Produced by X-rays on Animal Tissues: Destructive and Hyperplastic Action of X-rays; Practical Consequences in Regard to Radio-Therapy and Protection of the Radiologist: Dr. J. Clunet.

WEDNESDAY, JANUARY 7.

GEOLOGICAL SOCIETY, at 8.—The Ordovician and Silurian Rocks of the Lough Nafooey Area (County Galway): C. I. Gardner and Prof. S. H. Reynolds.—The Geology of the St. Tudwal's Peninsula (Carnarvonshire): T. C. Nicholas.

AËRONAUTICAL SOCIETY, at 8.30.—Wind Gusts and the Structure of Aërial Disturbances: Dr. W. N. Shaw.

THURSDAY, JANUARY 8.

CONCRETE INSTITUTE, at 7.30.—Factory Construction: P. M. Fraser.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Development of Electric Power for Industrial Purposes in India: H. R. Speyer.

FRIDAY, JANUARY 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, JANUARY 8, 1914.

LISTER AND HIS WORK.

Lord Lister: His Life and Work. By Dr. G. T. Wrench. Pp. 384. (London: T. Fisher Unwin, n.d.) Price 15*s.* net.

I APPROACHED Dr. Wrench's book with jealous suspicion. I was unfavourably impressed by his preface, the final paragraph of which contains the statement:—"Between Van Helmont and Lister nothing was added to the fundamental philosophy of disease." This over-coloration was an unpromising introduction to an account of the life and work of one of the greatest figures in medicine—Joseph Lister.

However, as I read I became more and more fascinated with the book. In addition to an unbounded enthusiasm for his task, the author has a detailed knowledge of the development of the antiseptic system, and understands that it was because Lister was a scientific investigator of the first order that he was privileged to make so great a contribution to the welfare of mankind. Further, Dr. Wrench's appreciation of the intellectual and moral greatness of Lister is so sincere that one forgives the occasional commission of some of the faults of journalism. The book is written throughout in an interesting and forcible style. Well-chosen anecdotes and extracts from Lister's addresses are interspersed, which recall the charm of his personality to those who knew him, and assist to present the beauty of his character to those who had not this privilege.

The preliminary chapters are devoted to a short account of Lister's childhood, student days, and the first portion of his professional career at Edinburgh. The importance of his early scientific investigations and their bearing upon the great work of his life is made clear. Then follows an account of the condition of the surgical wards of a hospital in pre-Listerian days. The picture is painted in lurid colours, but, as the generation which remembers this condition is disappearing, it is necessary to impress upon the reader the immense human importance of the problem which occupied the attention of Lister.

The rest of the book is a history of the development and final triumph of the antiseptic method in surgery. The antiseptic system was based on the germ theory of putrefaction, which had been finally established by Pasteur. Pasteur himself was fully alive to the possible application of the facts he had discovered in the interpretation of infectious diseases, and was anxious to put his ideas to the test. At that time, however, he had neither access to hospitals nor a laboratory where he could work at infectious diseases of animals. His opportunity soon arrived, and, in the same year (1866) that Lister was applying the germ theory to explain the occurrence of wound infection, Pasteur, at the request of the French Government, was occupied with an investigation into the causation of pébrine. This disease of silkworms he discovered to be caused by infection by a protozoan parasite, Nosema, which is transmitted from the moth through the egg to the next generation of worms.

From his first contact with hospital wards Lister had been impressed with the terrible evils of wound infection, and sorely perplexed as to its causation. What most surgeons took as a matter of course was to him, even as a student, a phenomenon urgently demanding explanation, and whilst house surgeon at University College Hospital he searched with his microscope for a possible fungus as causal agent.

In 1865 Lister read the papers of Pasteur dealing with the necessity of microbes for putrefaction, which appeared in the *Comptes rendus* of the Paris Academy of Sciences. The analogy between the happenings in a flask of broth exposed to the air and a festering wound was obvious to a mind so prepared; nevertheless hundreds of doctors must have read Pasteur's papers and failed to see that they had any significance for their art.

All this is well told in the chapter entitled "Perplexity and Enlightenment," and in two interesting chapters which follow, a description of the first attempts to put the principle into practice, and the striking success attained in one of the most insanitary hospitals in the kingdom is given.

Notwithstanding, antiseptic surgery was slow in making headway. Many surgeons failed to appreciate that antiseptic surgery was a system based on a principle, and seemed to think that they could neglect the principle and apply plenty of carbolic. As a consequence, they obtained results little, if at all, better than by their old methods.

The gradual spread of the gospel of "Listerism" until its final acceptance is dramatically told. In order to enhance the effect, the author has painted a sombre background representing the obstinate stupidity of many of the profession, and, to this end, has quoted from the speeches and writings of distinguished surgeons criticisms and opinions which it seems almost cruel to revive. This certainly produces the effect of contrast, but the lustre shed by the work of Lister is sufficient to render the artifice unnecessary.

The climax was reached at the International Medical Congress at Amsterdam in 1879, when Lister's appearance called forth the greatest ovation ever witnessed at one of these assemblies. As the applause subsided, Prof. Donders, the president of the congress, stepped forth and said:—"Professor Lister, it is not only our admiration which we offer you; it is our gratitude, and that of the nations to which we belong."

The book concludes with an account of Lister's antiseptic technique, and the reasons on which it was based. This, in many respects admirable, is unnecessarily polemical. Like Dr. Wrench, I have no patience with those who would belittle the discoveries of Lister because it may be possible to attain the same end by a modification of his method; but the torrent of irony poured upon those surgeons who prefer to sterilise their dressings and tools by steam instead of by chemical means, or to adopt a number of precautions not found necessary by Lister, is, surely, uncalled for.

The elaborate equipment of the modern operating theatre is not, as many suppose, essential, but it is very convenient. The danger is that, by its obtrusive array of apparatus for sterilisation, the surgeon as well as the student may forget that it is impossible to sterilise the skin of the patient, so that it is, as Lister found, wiser to have a second line of defence in the form of an antiseptic dressing, which, although it may not destroy all the microbes in the area of operation, paralyses their activity until the wound has had time to close.

C. J. MARTIN.

SPECIALISED CHEMICAL TEXT-BOOKS.

(1) *Gas Analysis.* By Prof. L. M. Dennis. Pp. xvi+434. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 9*s*. net.

(2) *The Chemistry of Rubber.* By B. D. Porritt. Pp. vii+96. (London: Gurney and Jackson, 1913.) Price 1*s*. 6*d*. net.

(3) *An Introduction to the Chemistry of Plant Products.* By Dr. Paul Haas and T. G. Hill. Pp. xii+401. (London: Longmans, Green and Co., 1913.) Price 7*s*. 6*d*. net.

(4) *Grundriss der Fermentmethoden. Ein Lehrbuch für Mediziner, Chemiker, und Botaniker.* By Prof. Julius Wohlgemuth. Pp. ix+355. (Berlin: J. Springer, 1913.) Price 10 marks.

(1) GAS analysis enters into almost every branch of chemical work, and there is therefore no need to emphasise the importance of a standard work on the subject. Prof. Dennis began his book as a second edition of the English translation of Hempel's famous "Methods of Gas Analysis," but the inclusion in it of the advances made during the last fourteen years has turned it into a new book. Procedures for the determination of most of the common gases are given in considerable detail, but the book is rightly devoted mainly to rapid methods of technical gas analysis, including the determination of heating power as well as of quantity. The opening sections, occupying about one-third of the book, treat in turn of the collection, storage, measurement, and other manipulation of gases. The various forms of apparatus devised for gas analysis are described, a variety of important practical details being included. After describing fully the methods of analysis of the various simple gases, chapters are devoted to the investigation of flue gas, illuminating gas, acetylene, and air. Although remarkably complete, the book is not exhaustive; for example, no reference is made to Bone and Wheeler's valuable apparatus, first described in 1908. Only one of the automatic carbon dioxide recorders is described, whereas there are others on the market equally if not more satisfactory. However, these are only minor blemishes on a work which is likely to be widely used.

(2) Mr. Porritt is to be complimented on having compressed within narrow limits a very complete and readable account of the chemistry of rubber. His book can scarcely fail to be of great value to all who master it, and it should be of considerable service to those directly interested in the industry. As a practical man, the author is fully alive to the complexities of the problem presented by rubber, and his account of the advanced chemistry of its structure is combined happily with the more practical details of its working.

The first chapter deals with the properties of crude rubber, directing attention to its constituents and such properties as tackiness and perishing, which require scientific investigation, so that they may be prevented in the future. A neat summary is given of the chemical constitution of rubber and of its synthetic imitations. Sections 3 and 4 describe the process of vulcanisation and the various theories which have been put forward to explain it. We read with interest that Hancock, the first to utilise the process in England about 1842, conducted experiments from which any kind of scientific method was conspicuously absent! He was nevertheless successful! Although Mr. Porritt's book assures us that this is not the method of procedure in 1913, we cannot help feeling that if, a few years ago when money was plentiful in the industry, the plantation companies had endowed properly scientific research on rubber, they would not now be complaining of the unsatisfactory price which their product realises as compared with the wild article. The subject of synthetic rubber is fully treated, though no optimistic opinion is expressed as to its commercial success in the near future. The book ends with a bibliography giving 179 references to the original literature.

(3) The title of this work very accurately represents its contents; it is in no sense a text-book of plant chemistry, though it is intended for students of vegetable physiology. The plan adopted by the authors is to single out various groups of substances because they occur in plants, and to give some idea of their chemistry. Reference is usually made to the mode of occurrence of the particular compound, and occasionally to its biological significance or economic importance. From the point of view of the botanist, especially the junior student, the result is a valuable compilation of facts which were previously only to be found widely scattered. The authors are to be congratulated on the extent of their reading and the large amount of pertinent matter which they have introduced, much of which has not hitherto been found in text-books.

Viewed, however, from a somewhat higher standard of criticism, the book is disappointing. It lacks stimulus and feeling, both on the chemical and on the botanical side, and although informative it is not sufficiently critical to guide the user on just those questions where he needs information. If chemistry is to be of real aid to the biologist, he must realise its broader issues and acquire some chemical feeling. This it is impossible to gain from a book dealing with the reactions and properties of selected substances, and the introduction of such methods of teaching chemistry to biologists is to be deprecated on all grounds.

The writers are at their best in some of the more advanced sections, those dealing with the tannins and with plant pigments being admirably done. The other chapters are devoted to fats, carbohydrates, glucosides, nitrogen bases, colloids, proteins, and enzymes.

(4) Dr. Wohlgemuth in his preface claims to have collected together all the experimental methods which are of use for the study of enzymes, but we fear he will find it difficult to establish his claim. Indeed, the book is disappointingly superficial, the more so as there is a real need for it just at present. Many of the best and most generally used processes are entirely ignored, and there are far too many inaccuracies and loose statements. In particular, the author appears to have paid no attention at all to the very large bulk of English and American work on the subject, either in the original or in the excellent abstracts in the German journals which must have been available to him.

The carbohydrate enzymes are very incompletely treated, and the same applies to diastase. The estimation of this enzyme is so important for the brewing industry that it has been very thoroughly studied, and methods of great accuracy have been elaborated, for which we look in vain. Emulsin scarcely receives mention, in spite of its importance in plant physiology, and of the newer work on it we find not a trace. The information about urease is equally scanty. The author is more lengthy and presumably more at home on the pathological side of the subject, and he appears to cater specially for medical men who propose to make the detection of enzymes of advantage in diagnosis. It is desirable to emphasise the danger of this practice—the technique of enzyme identification is not easy, and insufficiently qualified workers are prone to obtain misleading results. Physiological chemical literature is already burdened with so much that is incorrect that no encouragement should be given to practices which are likely to lead to a continuance of the evil.

E. F. A.

THE REGULATION OF NAVIGABLE RIVERS.

The Improvement of Rivers. By B. F. Thomas and D. A. Watt. In two volumes. Pp. xv + 749 + 76 plates. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 31*s.* 6*d.* net.

THIS is the second edition of a book published in New York in 1903. The authors are assistant engineers in the service of the United States, and have drawn to a considerable extent on their personal experience of works carried out in that country. The subjects dealt with are:—Chap. i., The characteristics of rivers; ii., Regulation of river channels; iii. and iv., Dredging and Snagging; v., Embankments and their protection; vi., Levees; vii., Storage reservoirs; viii., The improvements of the outfalls of rivers. The second part relates principally to the canalisation of rivers. Tidal rivers are not dealt with.

The text is accompanied by a great number of illustrations explanatory of the works described. These two volumes contain much useful information relating to the subject dealt with, and are well worth the study of engineers engaged in this class of work.

The authors direct attention to a fact that should be borne in mind by engineers engaged in river training, that experience has shown that although water is a fluid element without cohesion, influenced by the laws of gravitation, yet it cannot be made to flow in any desired direction unless the training works are carried out subject to rules which experience has dictated. All flowing water moves under the guidance of natural laws which produce in their combinations complex results, which must be taken into consideration fully if favourable results are to be obtained from the regulation of river channels.

One subject dealt with at some length which deserves the careful attention of river engineers is the prevention of floods by regulating the flow of the water by means of natural or artificial reservoirs. It is not for want of example that this important subject has not received the attention that it deserves. So long ago as the time of the Pharaohs, the regulation of the Nile was effected by the construction of Lake Mœris. Advantage was taken of a large natural depression near the river, covering an area of 695 sq. miles. This was embanked, and a channel cut connecting the lake and the river. In times of extraordinary high Nile, an opening was cut in the embankment and the water from the river allowed to flow through the cut to the artificial lake; when the flood subsided the cut in the bank was made up again.

In America the great lakes form a practical object-lesson as to the use of storage reservoirs. These operate to preserve a balance between the cycles of wet and dry seasons, and so regulate the depth of the water in the rivers with which they are connected, to the advantage of navigation in dry seasons, and the prevention of floods when the rainfall is excessive.

The largest artificial reservoir that has been constructed in the United States is that at the head of the Mississippi. The country in the neighbourhood of the source of this river is interspersed with a great number of small lakes and depressions. About thirty years ago, following the Egyptian example, embankments were constructed to hold up the water over this area in wet seasons, and works carried out to enable this to flow out when the river could take it without causing floods. In Italy the lakes adjacent to the northern tributaries of the Po have in like manner been adapted to serve the same purpose. The flow of the Rhine in its upper part is also regulated by the lakes with which it is connected.

One of the most extensive modern artificial systems of regulation is to be found in Russia, at the head waters of the Volga and Msta rivers, where, by the embankment of a large tract of low swampy land, the flow of water in the Volga has been so regulated that the length of time over which navigation is practicable in dry seasons has been increased by three months.

The most recent example of river regulation in Europe has been carried out in Silesia, where, on an average, the river Oder overflowed its banks and flooded the country through which it flows once in eight years. The loss to the inhabitants caused by the last of these floods was estimated at half a million pounds. The scheme adopted has been to form a series of reservoirs by constructing embankments across the valley and holding up the water when the river is not able to carry off the rainfall.

OUR BOOKSHELF.

The Wonders of Wireless Telegraphy. By Prof. J. A. Fleming, F.R.S. Pp. xi + 279. (London: S.P.C.K., 1913.) Price 3*s.* 6*d.* net.

DR. FLEMING'S reputation as inventor, experimenter, theorist, and expositor in the domain of wireless telegraphy is so high that any work by him upon this fascinating and difficult subject will be welcome. We already have learned to look to his advanced and mathematical works for guidance when seeking to understand the intricacies of spark or æthereal telegraphy. In the present book, however, Dr. Fleming has undertaken a task which in many ways is more difficult than writing an advanced treatise, for he has attempted, and his success is great, to unfold the nature of the operations on which this new art depends without the use of mathematical or very technical language. This book is to be considered as a continuation of, or addition to, "Waves and Ripples in Water, Air, and Æther," by the same author.

Without following the treatment of the several chapters, special reference may be made to the fifth chapter, which is of particular interest, as we there find the most recent views on long-distance transmission as not affected by the curvature of the earth, but susceptible to peculiarities of weather, and, above all, to the effect of the rising or setting sun. Another feature is the discussion of the methods of transmission by intermittent spark, continuously existing arc, and various mechanical methods of obtaining continuous waves or nearly so, and this it would appear might be read to advantage by some whose knowledge of electrodynamics is greater than their familiarity with the everyday difficulties met with in working commercially.

The chapter on the wireless telephone is also one which will appeal to every reader.

(1) *Who's Who*, 1914. Pp. xxx + 2314. Price 15*s.* net.

(2) *Who's Who Year-Book for* 1914–15. Pp. vii + 178. Price 1*s.* net.

(3) *The Englishwoman's Year-Book and Directory*, 1914. Edited by G. E. Mitton. Pp. xxxii + 441. Price 2*s.* 6*d.* net.

(4) *The Writers' and Artists' Year-Book*, 1914. Edited by G. E. Mitton. Pp. x + 157. (London: Adam and Charles Black.) Price 1*s.* net.

(1) THE best praise which can be given to the sixty-fifth issue of "Who's Who" is to say that it maintains the high standard of excellence of previous editions. We notice that it has increased in size by nearly a hundred pages, and that, as

usual, a prominent place is given to the biographies of eminent British and foreign men of science. We know of no more useful work of reference, or of one which is consulted more frequently.

(2) This supplement to "Who's Who" contains a remarkable miscellany of information as to the offices held by distinguished men and so on, arranged conveniently in tabular form to assist rapid reference.

(3) With the assistance of an honorary consultative committee of women workers eminent in their respective spheres of activity, the editor has compiled an indispensable compendium of information for all women who participate in public or social life. Parents desiring guidance as to careers for their daughters will find this volume very helpful.

(4) The sub-title of this book, "A Directory for Writers, Artists, and Photographers"—exactly describes its scope and intention, which are fulfilled successfully.

Papers of the British School at Rome. Vol. vi. Pp. xiv + 511 + xl plates. (London: Macmillan and Co., Ltd., 1913.) Price 42*s.* net

The severely archæological part of this work consists of reports of excavations in Malta and Gozo made in 1908–11, and of a survey of the megalithic monuments of Sardinia. The investigation was confined to Neolithic monuments. Buildings usually ascribed to the Phœnicians are now assigned to the end of the Neolithic age, or to the very beginning of the "Eneolithic" period or the age of metals (p. 5). They were "in part sanctuaries, in part dwellings." No Neolithic burials were discovered in them, but typical Neolithic burials were found elsewhere under other conditions (pp. 7, 8, 12). Such evidence fully warrants the happy description "megalithic sanctuaries" (p. 35). "Connection of origin with the pottery of the Ægean there is apparently none; at any rate, it is so remote that we cannot trace it, and of direct Ægean influence," says Mr. Peet, "I can see no certain evidence whatsoever." The builders were evidently allied to the people who made "the rock-hewn graves of Sardinia, Spain, and perhaps Sicily" (p. 17).

But the "sanctuaries" of Malta are, according to the second report, "dolmenic tombs" in Sardinia. As no evidence of burial is produced, one is forced to think that the investigation in that quarter is in the "dolmenic tomb" period of research. It is all about the "cult of the dead," with the dead conspicuously absent. In the first report Dr. Ashby says: "I do not think that it is possible to accept the idea of Evans that these mounments 'served, in part at least, a sepulchral purpose.'" (p. 8).

Excellent plans disclose orientations which rank in well-known categories, and the linear measures dovetail into striking harmonies, but the "British School at Rome" seems to care little for such trifles. Nowhere one finds the suggestion that the "sanctuaries" were also observatories.

John Griffith.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Pressure of Radiation and Carnot's Principle.

As is well known, the pressure of radiation, predicted by Maxwell, and since experimentally confirmed by Lebedew and by Nichols and Hull, plays an important part in the theory of radiation developed by Boltzmann and W. Wien. The existence of the pressure according to electromagnetic theory is easily demonstrated,[1] but it does not appear to be generally remembered that it could have been deduced with some confidence from thermodynamical principles, even earlier than in the time of Maxwell. Such a deduction was, in fact, made by Bartoli in 1876, and constituted the foundation of Boltzmann's work.[2] Bartoli's method is quite sufficient for his purpose; but, mainly because it employs irreversible operations, it does not lend itself to further developments. It may therefore be of service to detail the elementary argument on the lines of Carnot, by which it appears that in the absence of a pressure of radiation it would be possible to raise heat from a lower to a higher temperature.

The imaginary apparatus is, as in Boltzmann's theory, a cylinder and piston formed of perfectly reflecting material, within which we may suppose the radiation to be confined. This radiation is always of the kind characterised as complete (or black), a requirement satisfied if we include also a very small black body with which the radiation is in equilibrium. If the operations are slow enough, the size of the black body may be reduced without limit, and then the whole energy at a given temperature is that of the radiation and proportional to the volume occupied. When we have occasion to introduce or abstract heat, the communication may be supposed in the first instance to be with the black body. The operations are of two kinds: (1) compression (or rarefaction) of the kind called *adiabatic*, that is, without communication of heat. If the volume increases, the temperature must fall, even though in the absence of pressure upon the piston no work is done, since the same energy of complete radiation now occupies a larger space. Similarly a rise of temperature accompanies adiabatic contraction. In the second kind of operation (2) the expansions and contractions are *isothermal*—that is, without change of temperature. In this case heat must pass, into the black body when the volume expands and out of it when the volume contracts, and at a given temperature the amount of heat which must pass is proportional to the change of volume.

The cycle of operations to be considered is the same as in Carnot's theory, the only difference being that here, in the absence of pressure, there is no question of external work. Begin by isothermal expansion at the lower temperature during which heat is taken in. Then compress adiabatically until a higher temperature is reached. Next continue the compression isothermally until the same amount of heat is given out as was taken in during the first expansion. Lastly, restore the original volume adiabatically. Since no heat has passed upon the whole in either direction, the final state is identical with the initial state, the tem-

[1] See, for example, J. J. Thomson, "Elements of Electricity and Magnetism" (Cambridge, 1895 § 241): Rayleigh, *Phil. Mag.* (xlv., p. 222, 1898): "Scientific Papers" (iv., p. 354).

[2] *Wied. Ann.*, vol. xxxii., pp. 31, 291, 1884. It is only through Boltzmann that I am acquainted with Bartoli's reasoning.

perature being recovered as well as the volume. The sole result of the cycle is that heat is raised from a lower to a higher temperature. Since this is assumed to be impossible, the supposition that the operations can be performed without external work is to be rejected—in other words, we must regard the radiation as exercising a pressure upon the moving piston. Carnot's principle and the absence of a pressure are incompatible.

For a further discussion it is, of course, desirable to employ the general formulation of Carnot's principle, as in a former paper.[3] If p be the pressure, θ the absolute temperature,

$$\theta\frac{dp}{d\theta}=\mathrm{M} \quad . \quad . \quad . \quad . \quad . \quad . \quad (29),$$

where $\mathrm{M}dv$ represents the heat that must be communicated, while the volume alters by dv and $d\theta=0$. In the application to radiation M cannot vanish, and therefore p cannot. In this case clearly

$$\mathrm{M}=\mathrm{U}+p \quad . \quad . \quad . \quad . \quad . \quad . \quad (30),$$

where U denotes the volume-density of the energy—a function of θ only. Hence—

$$\theta\frac{dp}{d\theta}=\mathrm{U}+p \quad . \quad . \quad . \quad . \quad . \quad (31).$$

If we assume from electromagnetic theory that

$$p=\tfrac{1}{3}\mathrm{U} \quad . \quad . \quad . \quad . \quad . \quad . \quad (32),$$

it follows at once that

$$\mathrm{U}\propto\theta^4 \quad . \quad . \quad . \quad . \quad . \quad . \quad (33),$$

the well-known law of Stefan.

In (31) if p be known as a function of θ, U as a function of θ follows immediately. If, on the other hand, U be known, we have

$$d\left(\frac{p}{\theta}\right)=\frac{\mathrm{U}}{\theta^2}d\theta,$$

and thence

$$\frac{p}{\theta}=\int_0^\theta\frac{\mathrm{U}}{\theta^2}d\theta+\mathrm{C} \quad . \quad . \quad . \quad . \quad . \quad (34).$$

RAYLEIGH.

[3] "On the Pressure of Vibrations," *Phil. Mag.*, iii., p. 338, 1902; "Scientific Papers," v., p. 47.

"Atmospherics" in Wireless Telegraphy.

THE greatest difficulty in wireless telegraphy is due to atmospherics. I believe that every attempt to prevent these sudden shocks from entering the receiving apparatus in important stations has failed. Now Mr. S. G. Brown has wires stretched horizontally from his house to his stables in Kensington at about 40 ft. from the ground; he receives all the ordinary messages and time signals with practically no sign of atmospherics. Of course, lessening the height of high antennæ lessens the energy received, but it seems that the diminution of the blow is much greater than the diminution of ordinary signals. One of Brown's latest relays magnifies the currents in the receiving apparatus one hundred times, and he expected that the signals would be well received, in spite of the lowness of his wires, but he was surprised to find that the blow, the atmospheric, had almost altogether disappeared. In fact, there was no blow to magnify. I believe that the Salcombe Hill Observatory arrangement for receiving time signals is also free from atmospherics, its antennæ being quite low, and a Brown relay being used.

If the following explanation of this curious phenomenon is correct, it ought to be easy to destroy atmospherics however high the antennæ may be.

An antenna is affected by rays of all frequencies because its vibrations are damped by resistance, although it is, of course, most sensitive to rays of its own frequency. An atmospheric is of the nature of a sudden shock; it consists of rays of all frequencies, and particularly of rays of all sorts of very high frequencies. Suppose the frequency of the antenna to be anything from 50,000 to 300,000 per second; let us say 100,000. I take it that houses and trees are very imperfect antennæ the frequencies of which are probably much greater than 100,000 generally, although sometimes less. When rays are proceeding horizontally the æther in the neighbourhood of trees and houses is therefore greatly robbed of all energies which accompany waves of high frequency. In fact, all rays of frequencies corresponding to the frequencies of trees and houses are absorbed, and a low antenna of frequency 100,000 receives but little energy of other frequencies than its own, and therefore little of the "atmospheric" blow. If this explanation is correct, it is only necessary to surround a receiving antenna by numerous others of all sorts of high frequency. If I am right it is scarcely possible to receive atmospherics in the middle of a large city unless the ground is much higher than neighbouring ground, just as we know that an ordinary house in the middle of a city is never struck by lightning.

My explanation cannot be complete, for the man in charge of a coast station in the Mediterranean states that he has difficulty in receiving signals because disturbing atmospherics are so numerous, whereas ships in the neighbourhood, or even five miles away, are comparatively undisturbed in their signalling. Now these ships are far away from trees and houses.

Again, Mr. Brown tells me that although he receives no atmospherics from great distances, his signals are certainly disturbed by local thunderstorms. In fact, he can predict the coming of a thunderstorm when it is probably twenty miles away. My explanation may be defended by saying that the fronts of the Maxwell waves are not vertical in such cases. Again, I have been told that without altering the antenna at a receiving station, if we tune it to a lower frequency, there is more disturbance from atmospherics. It is possible that this is not generally true, but only true for certain stations, and, if so, my explanation may escape censure.

JOHN PERRY.

December 30, 1913.

Columbium versus Niobium.

AT a meeting of the council of the International Association of Chemical Societies in Brussels, last September, a committee on inorganic nomenclature, among other recommendations, endorsed the name and symbol "niobium" and "Nb," for the element which was originally named columbium. As this recommendation is historically erroneous, a brief statement of the facts appears to be desirable.

In 1801 Hatchett, an English chemist, analysed a strange American mineral, and in it found a new metallic acid, the oxide of an element which he named columbium. A year later, Ekeberg, in Sweden, analysed a similar mineral from Finland, and discovered another element, which he called tantalum. Wollaston, in 1809, undertook a new investigation of these elements, and concluded that they were identical, a conclusion which, if it were true, would have involved the rejection of the later name, and the retention of the earlier columbium. The accepted rules of scientific nomenclature make this point clear.

For more than forty years after Hatchett's discovery both names were in current use; for although Wollaston's views were accepted by many chemists, there were others unconvinced. In 1844, however, Heinrich Rose, after an elaborate study of columbite and tantalite from many localities, announced the discovery of two new elements in them, niobium and pelopium. The latter supposed element was afterwards found to be non-existent, but the niobium was merely the old columbium under a new name. That name in some mysterious manner was substituted by the German chemists for the original appropriate name, and has been in general use in Europe ever since. In America the name columbium has been generally preferred, and was formally endorsed by the Chemical Section of the American Association for the Advancement of Science more than twenty years ago. In England, also, columbium is much used, as, for example, in Roscoe and Schorlemmer's "Treatise on Chemistry," Thorpe's "Dictionary of Applied Chemistry," and the new edition of the "Encyclopædia Britannica."

The foundation of Rose's error seems to have been an uncritical acceptance of Wollaston's views; for he speaks of all the minerals he studied as tantalite. He also, at least in his original memoir, claims that the atomic weight of niobium is greater than that of tantalum, and here he was obviously wrong.

In short, the name columbium has more than forty years' priority, and during that interval was accepted by many chemists, and was more or less in current use. To employ the name niobium is not only unhistorical, but it is also unfair to the original discoverer, meaningless, and without any justification whatever. Furthermore, it injures the splendid reputation of Rose, for it perpetuates and emphasises one of his few errors. The recommendation of the committee above-mentioned should not be accepted, for it is opposed to the established rules of priority.

F. W. CLARKE.

A New Etching Reagent for Steel.

WHAT I believe to be a novel and useful reagent for the etching of steel specimens for microscopic examination has recently been worked out in this laboratory by the writer, in conjunction with Mr. J. L. Haughton. A very brief account in this place is perhaps justified in view of the fact that the opportunity for publishing a full account of the work in the usual way will not occur for some months.

The etching reagent consists of an acid solution of ferric chloride, similar to that frequently used for etching copper alloys, but containing about 0·1 per cent. of cupric chloride and about half that quantity of stannic chloride. The copper in this solution is, of course, displaced by the iron of any steel specimen exposed to it, and the copper is deposited on the surface of the steel. We have, however, discovered that in ordinary carbon steels this action can be made to occur in such a way that a thin deposit of copper is slowly formed on the ferrite, while pearlite and cementite are only very slightly affected. Under the microscope the ferrite appears to be blackened, while the pearlite remains bright. The appearance of the etched specimens is thus the exact negative of that obtained by ordinary reagents, provided that the steel is very pure. We have found, however, that in commercial steels the ferrite is not darkened uniformly, but that a strongly banded structure is developed. Apparently the rate of deposition of copper is greater the purer the ferrite, one of the most important impurities in this regard being phosphorus. By a suitable use of the reagent, patterns are obtained which indicate the distribution of the phosphorus in a clear and striking manner, and it is thus possible to obtain in two minutes by the use of the new reagent results hitherto only obtainable by the process of "heat tinting."

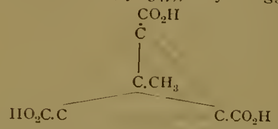
By the kindness of Dr. J. E. Stead, F.R.S., we have been enabled to compare the patterns obtained by heat-tinting on one of Dr. Stead's own specimens and those obtained by means of our reagent on the same surface after repolishing, and these patterns have proved identical. Beyond this, however, the new method of etching by the electro-chemical deposition of another metal promises to open up many possibilities in the study of the structure of metals, but these we have not yet had time to work out.

WALTER ROSENHAIN.

The National Physical Laboratory,
(Wernher Metallurgy Laboratory),
December 31, 1913.

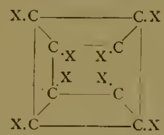
Dr. J. F. Thorpe's "Caged" Compound.

As Dr. J. F. Thorpe has apparently found difficulty in representing his newly discovered tricarboxylic acid by a formula in the plane of the paper (*vide* Proc. Chem. Soc., vol. xxvii., p. 347), may I suggest



as being as good as the one he suggested if not preferable to it.

A "caged" cube compound, C_8X_8, could similarly be advantageously represented by the projection formula:—

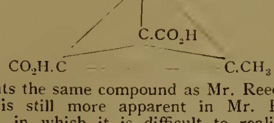


W. W. REED.

Technical Institute, Norwich,
December 16, 1913.

MR. REED is quite right, and doubtless the formula he suggests will have to be adopted for this and similar compounds when it is desired to express their structure graphically on the plane of the paper.

It is, however, evident, as Prof. Armstrong stated at the meeting of the Chemical Society, that a large number of organic compounds are very inadequately represented by the usual two dimensional formulæ, and that it will be necessary, in the near future, to reconsider our method of portraying the structure of these substances. The isolation of the compound under discussion, for which, on Prof. Armstrong's suggestion, the name methyl-tetrahedrene tricarboxylic acid has been adopted, merely serves to accentuate the limitations of our present method, for it is evident that the formula suggested by Mr. Reed does not represent the true relative positions of the carbon atoms in the molecule. For example, it is difficult to understand that the formula



represents the same compound as Mr. Reed's formula.

This is still more apparent in Mr. Reed's cube formula, in which it is difficult to realise that the eight carbon atoms are of equal value.

J. F. T.

Lucretius or Kapteyn?

NONNE vides etiam diversis nubila ventis diversas ire in partis inferna supernis? Qui minus illa queant per magnos ætheris orbis æstibus inter se diversis sidera ferri? *De Rerum Naturâ*, v., 646–9.

See you not too that clouds from contrary winds pass in contrary directions, the upper in a way contrary to the lower? Why may not yon stars just as well be borne on through their great orbits in ether by currents contrary one to the other?

Munro's Translation.

E. J. M.

Semi-absolute.

THE biologist, even the most mathematical, envies and admires the greater precision of statement and language that is possible for the physicist, and the physicist in his turn is apt to plume himself on the fact that his sciences, as compared with those of the biologist, are the exact sciences. Some biologists interested in precision of terminology have been wondering what the physicist may mean by the term "semi-absolute"—a term which will be found applied to volts in the title of a paper recently read before the Royal Society (NATURE, December 25, 1913, p. 495, column 1). On the face of it, semi-absoluteness is no more easy to conceive than is semi-infinity, and one is therefore tempted to regard the phrase akin to the "quite all right" of the modern young lady, the "quite a few" of the American, and other such degeneracies of modern speech. That view must, of course, be wrong, but an explanation would be comforting to more than one ENQUIRER.

THE MAKING OF MOUNTAINS.[1]

THE object of the very attractive volume before us, as stated by its author, is to supply geographers with such a knowledge of geological processes as is necessary for understanding the origin of the orographic features of the earth's surface. With this purpose in view, technical details are—so far as is possible—avoided, while disputed and doubtful topics are, as a rule, kept in the background; while by vivid and picturesque descriptions, aided by admirable photographic illustrations and diagrams, the reader is made acquainted with the chief types of mountain forms and the agencies by which they have been produced.

Photo.] [*Wehrli, Zürich.*

FIG. 1.—The Bifertenstock and Frisal, seen from the Firn plateau of the Tödi. Eocene and Mesozoic strata resting upon Gneiss. From "Mountains: their Origin, Growth, and Decay."

The great majority of the elevations of the land are classed as "original or tectonic," the building-up of these structures being due to many diverse agencies; only a small residue of the relief-forms are grouped as "subsequent or relict" mountains, being the result of operations that, by removing the surrounding materials, have left great upstanding masses behind.

First among the tectonic mountains are included those of volcanic origin, grouped by the author as "débris cones," which are made up of fragmental materials, usually of igneous origin but often accompanied by detritus from aqueous

[1] "Mountains: their Origin, Growth, and Decay." By Prof. James Geikie, F.R.S. Pp. xix+311+lxxx plates. (Edinburgh: Oliver and Boyd, London: Gurney and Jackson, 1913.) Price 12s. 6d. net.

and metamorphic rocks; in the second place, we have "lava-cones" built up entirely by outwelling streams of liquid rock from a fissure; and, thirdly, "composite cones" built up by alternating ejections of fragmental materials and lavas. The varied slopes of cones, as determined by the nature of the fragmental materials or the degree of liquidity of the lavas, are well explained and illustrated. The very graceful forms assumed by some volcanoes—which is so conspicuously illustrated by the representation of the famous Japanese mountain Fujiyama—are explained by the author as being due to the larger ejected fragments accumulating nearest to the crater, but it may be in part also due to central subsidence. Such subsidence is admitted by the author to have from the ocean-floor to a height of 30,000 ft., while, so gentle are their slopes, they have diameters of more than 80 miles. At the other end of the scale, and as a supplement to the catalogue of volcanic mountains, geyser-cones and mud-volcanoes ("air volcanoes" of the author) are noticed.

In contrast to the elevations produced by the heaping up of materials brought from below the earth's surface we have "epigene types," formed by superficial detritus piled up either by glacial or æölian agencies. To the former class belong moraines of all kinds—sometimes forming hills more than 800 ft. in height—with the less conspicuous but more extended terrestrial features known as drumlins and eskers. As the result of

Photo.] [*Detroit Pub. Co.*

FIG. 2.—Mount Rainier (or Tacoma), Washington, U.S.A. An extinct composite volcano—snow capped and supporting glaciers. From "Mountains: their Origin, Growth, and Decay."

taken place in the formation of some volcanic craters like that of the celebrated "Crater-lake" of Oregon. The results of denudation on volcanic cones is well illustrated. In describing the manner in which younger volcanic cones rise within old craters, the author unfortunately speaks of "cone-in-cone" structure, a term which has already been appropriated by geologists for a totally different phenomenon. As illustrating the vastness of the agencies by which volcanic mountains are built up, the author justly points out that the great cones of the Hawaiian Islands must be regarded as the grandest orographic feature on the globe, seeing that these cones rise wind-action, we have the sand dunes of sea-coasts and the far more extensive structures of the same kind characteristic of deserts.

In passing from the comparatively simple "mountains of accumulation" to the opposite class, to which he gives the name of "deformation mountains," our author approaches, as he himself admits, the most difficult part of his task. He commences by giving an outline of the history of the development of our knowledge of the subject, in which he justly lays stress on the important effect of Lyell's protest against the orographic theories of de Beaumont; and he goes on to indicate the value of the subsequent work of the brothers Rogers in the Appalachian mountains of the United States. The great majority of the "deformation mountains" are shown to be undoubtedly "folded mountains," and, as may be expected in a work of this kind, the important light thrown u... mountain-origin by the study of the Scottish Highlands, as a mountain chain dissected by denudation, is admirably explained, though we miss any reference to the value of the labours of Nicol and Lapworth in this connection. The varieties of folding and the relations between folding and "thrusts" find full illustration; and the theoretical views of Heim, Steinmann, Suess, and other continental authors on the nature, extent, and results of the great complexities exhibited in the Alps, with their possible causes, are fairly stated though not fully discussed. The influence of jointing and weathering in producing the various types of alpine scenery rightly occupies a very important place in the work.

A second class of "dislocation mountains" includes curious types recognised in recent years by the geologists of the United States, with the "horsts" of German geologists. In all of these, extensive faulting—like that by which the mountains of Moab are left in relief by the great Dead-Sea fault—has been the chief agency concerned in their formation.

The mountains carved by denudation out of great igneous masses (the so-called "laccolites" and "batholites") constitute the author's third class of "deformation mountains," and are illustrated by the Henry mountains of North America and the Red Hills and Coolin Hills of Skye. It is here that we detect a little want of consistency in the classification adopted by the author. In describing his volcanic mountains he rightly refers not only to the denuded remains of small cones—commonly called "necks"—but to masses of lava, like the North Berwick Law, or of lava and tuffs like Largo Law, which are so conspicuous in the Scottish Lowlands as forming the denuded cones of great volcanoes. But the similar masses in Skye and the other islands of the Inner Hebrides do not differ from these in anything but their greater dimensions, and it seems scarcely justifiable to place them in a totally different class.

The final chapter of the book is devoted to the examples which the older geologists styled "mountains of circumdenudation," but which the author designates "subsequent or relict" mountains, of which we have such striking British examples in the great stacks of Torridon sandstone in western Sutherland and Ross.

Not less instructive than the text of this excellent work is the selection of eighty photographic plates which illustrate it. One-half of these is taken from the admirable series prepared by the Geological Survey of Scotland, and they show how rich our country is of examples of mountain structure; the other half consists of pictures supplied by photographers of Switzerland and the United States.

J. W. J.

ZONAL STRUCTURE IN PLANTS AND ANIMALS.[1]

WHEN a drop of strong silver nitrate is placed on a thin layer of 5–10 per cent. gelatine containing about 0·1 per cent. of potassium bichromate, remarkable phenomena are observed. The gelatine under the drop is coloured red-brown by the abundant precipitation of silver chromate. The nitrate spreads gradually by diffusion into the gelatine, the rusty brown area of precipitation enlarges, it forms at its periphery a dull whitish seam, and further outwards in the gelatine a system of numerous concentric rings is developed, spreading like rings on the surface of a quiet pool. These are the well-known Liesegang's rings or zones, and the central idea of Prof. Küster's investigation is that these throw light on zoned structure in cells and tissues. He has made numerous experiments with the diffusion zones formed in colloidal media *in vitro*, and he seeks to utilise the phenomena observed in the interpretation of organic structures—such as cross-striping in leaves, annular and other markings in cells and vessels, the layers in starch-grains, the markings on diatoms, the lines on butterflies' wings, on shells, on feathers, on porcupines' quills, and what not.

Ostwald's explanation of Liesegang's rings is not unanimously accepted, but no one doubts that the phenomenon will be cleared up in terms of laws of diffusion, concentration, precipitation, and the like. Prof. Küster does not go into that; his object is to make zoned structure in organisms more intelligible by bringing it into line with Liesegang's rings. He is aware of the risks of arguing from the conditions of inorganic processes to those of organic processes, of mistaking similarity for sameness—and he quotes the wise advice that Roux has given in connection with this kind of argument.

Prof. Küster admits that his suggestion is only at the stage of hypothesis, for we do not know much about the active substances the diffusion of which in cells may induce zoned structure. We cannot isolate them and experiment with them. On the other hand, Prof. Küster points out that organisms are largely built up of colloid material, and that his experiments *in vitro* were with colloidal material, that artificially induced modifications of Liesegang's rings find their parallel in organic structure, and that the zoned structure occurs in the most diverse kinds of plants. His experiments show that "rhythmic structure may arise without any rhythmic influence from the outer world, and that even simple diffusion processes can give rise to rhythmic structures." Is it not probable that analogous occurrences take place in the formation of zoned organic structure? It may be said that in living creatures the rhythms are characteristically dynamic, but our author replies to this by referring to Bredig's "pulsating

[1] "Ueber Zonenbildung in kolloidalen Medien." By Prof. Ernst Küster. Pp. 111+53 figs. (Jena: Gustav Fischer, 1913.) Price 4 marks.

systems," and the like, which may point a finger from a distance to the pulsating life of the cell.

Prof. Küster has opened up an exceedingly interesting line of inquiry, and he states his case in cautious and undogmatic manner. It appears to us that at this stage he would not have weakened his position by leaving out the reference to such complicated "structural rhythms" as the striping of vertebrate animals.

SHACKLETON'S TRANSANTARCTIC EXPEDITION, 1914.

THOUGH Sir Ernest Shackleton has adopted plans for an antarctic expedition that were formulated and published by me even before his return from his last expedition, and details of which have appeared since that time in various scientific journals, and in the public Press,[1] my view has always been that one explorer should not stand in the way of another, but as soon as one has secured money—a task more arduous than carrying out any plan whatever in the field—he should carry out whatever plan he pleases, and should receive, if he desires, any assistance that the other may be able to give. Therefore I welcome Sir Ernest Shackleton entering what has for a century mainly been, so to speak, the Scottish sphere of influence in the antarctic regions.

It is a curious fact that those who have done the most strenuous work on antarctic land have been seamen, while landsmen have been left to carry out the most strenuous work in antarctic seas, and it is, perhaps, for this reason that Sir Ernest Shackleton concentrates his attention again mainly on the land, whereas, as I have already pointed out,[2] it is a study of "antarctic seas that is at present most urgent, including an exploration and definition of the southern borders of those seas," that is to say, the coastline of the antarctic continent. This part of the programme cannot be efficiently carried out in the time that Sir Ernest Shackleton proposes to allow himself, either for necessary preparation or for his expedition. Hurry is unfavourable to detailed scientific research.

But no one is better fitted than Shackleton to carry out to a successful issue the transcontinental journey, as is shown by the brilliant way in which he conducted his south polar expedition in 1907–1909. Shackleton is a trained seaman and a capable business man, appreciative of the work that scientific people carry out under his leadership. Abundant testimony to this fact has been given by his former colleagues, especially Dr. D. Mawson, Prof. Edgeworth David, and Mr. James Murray. It is certain, therefore, that he will give his scientific staff every opportunity of carrying out important scientific research.

Granted that his ship is able to reach Coats Land or Luitpold Land—and this is entirely dependent on whether it is a good or bad ice year in the Weddell Sea—the expedition should endeavour to unite and chart in more detail Coats Land and Luitpold Land. It should endeavour to map out the coast line between Coats Land and Enderby Land, between Coats Land and Luitpold Land, and between Luitpold Land and New South Greenland. The investigation of New South Greenland is in itself one of the most interesting and difficult problems of Weddell Sea. Detailed soundings should be taken, especially to the south and west of those of the *Scotia* and *Deutschland*, so that, if new coastlines are not actually discovered, their presence and general outline may be indicated. This can be arrived at with a wonderful degree of accuracy. It is of great interest to obtain considerable quantities of bottom deposits, especially macroscopic specimens, along with indications of the distribution and drift of icebergs which have been the means of carrying them to the place where they have been deposited. The important discovery of Archæocyathinæ at a depth of 1775 fathoms in lat. 62° 10′ S., long. 41° 20′ W. is a lucid example of the value of this type of research, for it most certainly indicates that the Cambrian rocks found by Shackleton in the vicinity of the Beardmore Glacier stretch across Antarctica towards the shores of the Weddell Sea, and possibly form part of that mountain system seen by Morrell in about lat. 69° S.[3]

But will Shackleton be able to spend time to carry on these researches when the main object is to cross the antarctic continent? On her outward voyage the ship will be full to the gunwale with stores and equipment, and every effort must be made to find a suitable landing place along a practically unknown coast, to build a house, and set up the base camp for the tremendous task of crossing Antarctica, and this along a coast that Ross failed to reach because of heavy ice in 1843, that the *Scotia* failed to reach in 1903, where the *Scotia*, in 1904, was heaved right out of the water, and left stranded on the top of the ice, her keel being 4ft. above water-level, and where the *Deutschland*, in 1912, was beset and driven northward helplessly during the whole winter.

These are difficulties that may be met with again in the Weddell Sea, difficulties which have never been experienced by any ship in the Ross Sea, where no one has ever failed to reach the Ross Barrier. It is therefore to be hoped that Shackleton will not meet with such conditions, but will find a favourable season such as Weddell and Morrell found in 1823.

Once landed at or in the vicinity of Coats Land—more likely to the east than to the west—Shackleton starts his main objective. A meteorological station here will be of immense importance, and should be cooperative with those of the Argentine Republic in Scotia Bay and South Georgia. Detailed discussion of the meteoro-

[1] *Scottish Geographical Magazine*, vol. xxiv., No. 4, April, 1908; vol. xxvi., No. 4, April, 1910. NATURE, March 24, 1910, p. 101; and October 27, 1910, p. 551. "Polar Exploration," by W. S. Bruce, chap. x., pp. 252, 253. (Williams and Norgate, 1911.)

[2] "Polar Exploration," by W. S. Bruce, p. 247.

[3] Morrell's Voyages, 1822–31, Capt. Benjamin Morrell, 1832, chap. p. 69.

logical programme with Mr. R. C. Mossman is strongly advised. Magnetic work of the usual kind at the base station and, so far as possible, on the cross journey will fall in with other work that has been done; in both these departments of science it would be specially profitable to have other expeditions in the field synchronously. Local zoological and botanical work will also be of great interest. But, undoubtedly, solving some of the many great topographical and geological problems is the leading work to be done both in the vicinity of the base station and in the interior.

According to evidence at present at our disposal, Shackleton, if he penetrates southward from Coats Land, will gradually rise without much interruption over completely and heavily ice-clad land—over inland ice, in fact—until he reaches the South Pole, an ice-field that continues until it reaches the Beardmore Glacier and Axel Heiberg Glaciers. It would be a great triumph if, after Shackleton reached the South Pole, he could strike a new route, say, to the west of the mountains of South Victoria Land; but if this sacrifices the life or even limbs of the party, it is not worth attempting. Another expedition can carry out that work in time to come from the Pacific side. The intrinsic value of the expedition is to seek and find out what lies between Coats Land and the South Pole.

The route will probably be to the east of the antarctic continuation of the Andes, but possibly Shackleton may have to cross another range—the continuation of the South Victoria Land Mountains—but all is new, and all depends upon whether previous conceptions have been based on sufficient facts. It is expeditions such as Shackleton's that we require as the only way of obtaining data for the solution of many theories founded on too few facts. We therefore wish him all possible success, and trust that he will receive all the support he requires. The 50,000*l*. provided by a generous friend is an absolute minimum; 70,000*l*. is nearer the figure, and may we also trust that even another 10,000*l*. will be forthcoming to enable the gallant leader to have the scientific results of the expedition described in detail; for an expedition of this kind is not completely successful unless the technical results of the work are published.

William S. Bruce.

DR. WEIR MITCHELL.

Dr. Silas Weir Mitchell died at Philadelphia on January 4, and in him has passed away one of the most remarkable men of America. At different times in his life he took a place in the very first rank of experimental physiologists, of practical physicians, and of novelists.

Dr. Weir Mitchell was born at Philadelphia, February 15, 1829, and was educated at the University of Pennsylvania and the Jefferson Medical College. He began researches on various physiological subjects in 1852, and in 1860 he published his researches "On the Venom of the Rattle Snake," a work which, even at this day, remains a perfect model of what an investigation into the physiological action of a poison ought to be, and is of itself sufficient to establish his claim to a front rank amongst American physiologists, past or present.

During the American Civil War Dr. Weir Mitchell had charge of a hospital in which cases of injury to nerves by gunshot wounds were specially treated. In 1872 he published a book on the effect of such injuries. After the war was over his patients were scattered over many parts of the United States, and he was thus enabled to make some very extraordinary observations upon the effect of weather upon disease. He was struck by the fact that one day, for example, he would get a batch of letters from California, a day or two afterwards from Denver, and a day or two later from Chicago, in which the patients complained of pains in their old wounds. These coincidences led him to inquire into the cause of the pain, and on communicating with the meteorological office he found that a wave of rain and a wave of pain were passing simultaneously over the American continent from west to east at the same rate. The "rain area" and the "pain area" were concentric, but the pain area was much larger than the rain area. The radius of the rain area from the storm centre was 550 to 600 miles, while the radius of the pain area was 150 miles greater than this. As a consequence of this, patients in the rain area felt pains, and, seeing the rain, concluded that their pains were due to change of weather. Those in the pain area felt pains, but saw no rain, and could not understand why they were suffering, although the real cause of their pain was the climatic disturbance. He afterwards extended his observations to the effect of weather on chorea and infantile paralysis. The curve of cases of infantile paralysis closely corresponded with the curve of temperature, but no such relationship could be noticed in the case of chorea either with temperature, height of barometer, or relative humidity. But a very close relationship indeed could be observed between the number of attacks of chorea and the number of storm centres within a radius of 400 or even 750 miles of Philadelphia.

Dr. Weir Mitchell's attention having been thus directed to diseases of the nervous system, he was led to give special attention to the treatment of nervous diseases in women, and more especially to hysteria and neurasthenia. In the treatment of these diseases he effected a complete revolution, introducing the system of seclusion, rest, massage, and feeding, which is now known as the Weir Mitchell treatment. It has been extraordinarily effectual in very many cases which would have otherwise proved hopeless, and establishes his claim to rank as one of the greatest practical physicians of his time.

From the published catalogue of his works it appears that he did not begin to write novels or poems until 1880, when he published "Three Tales of the Older Philadelphia," and in 1882 he published some poems. From that time onward he continued to write poems and novels. The most successful of these was "Hugh Wynne," a novel which dealt with life and manners in Philadelphia at the time of the Revolution. This novel showed an intimate knowledge of the history of the time, and of the people who took part in the great national movement. The figures he described were no mere puppets, but seem to be living and breathing men and women, and the work was of such high literary excellence that it at once placed him in the foremost rank of American novelists. Of very few men can it be said that as a young man he took a first place amongst the physiologists, as a middle-aged man amongst the physicians, and as an elderly man amongst the novelists of his country. His extraordinary mental power was combined with an almost equally extraordinary bodily activity, so that until about a year before his death he would think nothing of a walk of ten miles.

As a host he was most cordial and genial; as a friend he was most kind, trusty, and true; and his great information, broad views, and power of expression made a conversation with him a pleasure, and a stay in his house a delight to be remembered for the rest of life. He seemed to possess in a very marked degree the power of saying and doing the right thing at the right moment. His loss leaves the world the poorer, and will be a personal sorrow to everyone who has ever known him.

Little more than a week ago I received a Christmas card from him headed, "The Star of Bethlehem," containing four verses of poetry printed, but signed in his own handwriting, and I think probably his own composition. In view of his death so soon afterwards, the last verse seems almost prophetic, and it gives such an insight into his feelings, character, and hopes that I think perhaps I may be allowed to quote it:—

"Still in our heaven of memory keep
Remembrance of the gifts He gave;
The guiding life, the star of love,
To glow for us beyond the grave."

LAUDER BRUNTON.

NOTES.

THE chief distinction of interest to the scientific world in the list of New Year Honours is the appointment of Sir Archibald Geikie, K.C.B., F.R.S., to the Order of Merit, in recognition of the eminent services which he has rendered to the nation and to the world at large in the science of geology. Mr. James Bryce, O.M., F.R.S., who retired recently from the post of British Ambassador at Washington, is created a viscount. Sir Christopher Nixon, Bart., professor of medicine in University College, Dublin, has been made a Privy Councillor in Ireland. Sir Rickman J. Godlee, Bart., president of the Royal College of Surgeons, has been made a Knight Commander of the Royal Victorian Order, and Sir William J. Collins has received a like honour. Among the forty new knights are Prof. E. Rutherford, F.R.S., Langworthy professor of physics, University of Manchester; Mr. R. Blair, education officer of the London County Council since 1904; Prof. H. B. Allen, professor of pathology, University of Melbourne; and Surgeon-General A. T. Sloggett, director, Medical Services in India. Major A. Cooper-Key, Chief Inspector of Explosives, Home Office, has been appointed a Companion of the Bath (C.B.); Dr. A. Theiler, director of veterinary research, Department of Agriculture, Union of South Africa, has been promoted to be Knight Commander of the Order of Saint Michael and Saint George (K.C.M.G.); and the new Companions (C.M.G.) of the same Order include Mr. A. G. Bell, Inspector of Mines, Trinidad; and Prof. J. Shand, professor of natural philosophy, University of Otago, New Zealand. Major J. D. E. Holmes, Imperial bacteriologist in charge of the veterinary laboratory at Muktesar, has been made a Companion of the Order of the Indian Empire (C.I.E.).

MR. W. POPPLEWELL BLOXAM, whose death we announced with regret last week, contributed to the Chemical Society many papers which testify to his work for the advancement of science. In the early 'nineties of last century he devoted his energies to the task of unravelling the mysteries surrounding the alkali polysulphides and their oxidation changes; no doubt his attention was turned in this direction by Debus, under whom he started his professional career. Having filled a position as *locum tenens* professor of chemistry at Presidency College, Madras, Bloxam was retained in India by the Government of Bengal to investigate the question of improving the cultivation and manufacture of indigo, and from 1902–5 much work was carried on at the Dalsingh Serai Research Station, culminating in a report in conjunction with H. M. Leak and R. S. Finlow, now cited as authoritative. The underlying chemical investigations are to be found in the Transactions of the Chemical Society. A further Government grant enabled Mr. Bloxam on his return to this country to continue his researches at Leeds, whence there emanated several papers for the Chemical Society, in conjunction with Prof. A. G. Perkin and others, on the constitution of indirubin, the analysis of indigo, and the like. Another subject which came under Mr. Bloxam's notice was the complexity of the proteids of blood, and in the Proceedings of the Physiological Society is to be found a paper dealing with the constitution of these compounds as they occur in horse serum. As a whole Mr. Bloxam's work was sound, and his death at a comparatively early age deprives us of a genuine enthusiast in the cause of chemical research.

DR. HUGO MIEHE, associate professor of botany in the University of Leipzig, has succeeded the late Prof. H. Potonié as editor of the *Naturwissenschaftlichen Wochenschrift*, published by Mr. Gustav Fischer, Jena.

DR. R. WORMELL, instructor in mathematics at the Royal Naval College, Greenwich, in 1873, headmaster of the Central Foundation School, London, from 1874 to 1900, and the author of several valuable works on scientific and educational subjects, died on January 6, at seventy-four years of age.

MR. C. B. ROBINSON, an American botanist, who was holding a temporary appointment under the Philippine Government, is reported to have been killed by natives of Amboyna Island, where he was engaged on a study of the local flora. He was forty-one years of age, and had been connected for some time with the New York Botanical Gardens.

A MEETING of members of the Wireless Society of London will be held at the Institution of Electrical Engineers on January 21, when an address, illustrated by experiments, will be given by the president, Mr. A. A. Campbell Swinton. By the courtesy of Le Commandant Ferrio, a vice-president of the society, the radio-telegraphic station of the Eiffel Tower, Paris, will send a special wireless message to the society during the meeting, and arrangements are being made to render the message audible to all present.

PROF. A. GARBASSO informs us that Mr. A. Lo Surdo, assistant professor in the R. Istituto di Studi Superiori, Florence, has succeeded in observing the Zeeman effect in an electric field announced by Prof. Stark in NATURE of December 4, 1913 (p. 401). Mr. Lo Surdo has observed that the effect is present in all vacuum tubes, but in a very short space immediately in front of the kathode. A photograph sent by Prof. Garbasso shows the line Hγ resolved into five components, but it is unsuitable for satisfactory reproduction. Two papers upon the subject have been presented to the R. Accademia dei Lincei, and will be published in the *Rendiconti* of the academy.

IN spite of appeals from several distinguished Americans, the Bill giving San Francisco extensive water supply and power rights in the Hetch-Hetchy Valley has passed both Houses of Congress, and becomes law by the signature of the President. One effect of the new Act will be to remove from the use and enjoyment of the general public the valley of the Tuolumne River in the north-western part of the Yosemite National Park. It is estimated that the provision prohibiting any refuse of men or animals from being deposited within 300 ft. of running water or of lakes tributary to the Tuolumne River above Hetch-Hetchy will exclude the public from one-half of the park. The Tuolumne Cañon, in particular, is described as containing some of the finest scenery in America, excelled only, if at all, by the Grand Cañon of the Colorado in Arizona.

THE eighty-second annual meeting of the British Medical Association is to be held next July at Aberdeen. The president-elect, who succeeds Dr. W. A. Hollis, of Brighton, is Sir Alexander Ogston, of Aberdeen. The annual representative meeting will begin on Friday, July 24; the president's address will be delivered on July 28, and the sections will meet on the three days following. The address in medicine is to be delivered by Dr. Archibald E. Garrod, and the popular lecture by Prof. J. Arthur Thomson. The sections of the council of the association with their presidents are:—Anatomy and Physiology, Prof. Robert W. Reid; Dermatology and Syphilology, Dr. Alfred Eddowes; Diseases of Children, including Orthopædics, Dr. John Thomson; Electro-Therapeutics and Radiology, Dr. Samuel Sloan; Gynæcology and Obstetrics, Dr. Francis W. N. Haultain; Laryngology, Rhinology, and Otology, Dr. Harry L. Lack; Medical Sociology, Dr. John Gordon; Medicine, Dr. F. J. Smith; Naval and Military Medicine and Surgery, Deputy-Surgeon-General M. Craig; Neurology and Psychological Medicine, Dr. F. W. Mott; Ophthalmology, Dr. C. H. Usher; Pathology and Bacteriology, Dr. W. S. Lazarus-Barlow; Pharmacology, Therapeutics, and Dietetics, Prof. J. T. Cash; State Medicine and Medical Jurisprudence, Prof. Matthew Hay; Surgery, Mr. John S. Riddell; Tropical Medicine, Prof. W. J. R. Simpson.

THE reports for the fifty-two weeks ended December 27, issued by the Meteorological Office, show that the mean temperature for 1913 was in excess of the average over the whole of the British Isles; the greatest excess was in the midland counties and the east of England, where it amounted for the whole year to nearly 2°. The rainfall was in agreement with the average in the south-east of England, and was in excess in Ireland and in the south-west of England; in all other districts there was a deficiency. The greatest deficiency of rain was 5·37 in. in the west of Scotland, and in the east of Scotland it was 4·53 in. In the English districts the greatest deficiency was 3·32 in. in the north-eastern district, and in the east of England the deficiency was 2·58 in. The rainy days were generally deficient in the eastern section of the kingdom and in excess in the western section. The duration of bright sunshine was below the average over the whole of the British Isles. The Greenwich observations give 51·5° as the mean temperature for the year, which is 1·5° in excess of the average. April, July, and August were the only months with a deficiency of temperature, the defect for the several months being respectively 0·4°, 3·8°, and 1·1°. The highest monthly mean was 61·8° in August. In July the highest temperature was 76°, and there was only one day with the temperature above the average, whilst the duration of bright sunshine was only ninety-five hours, which is ninety-one hours less than the average. There were in all only thirty-three nights with frost. The rainfall for the year was 22·00 in., which is 2·13 in. less than the average. The wettest month was October, with 3·58 in., the driest June, with 0·61 in. Rain fell on 169 days during the year, and January, March, and April each had twenty days with rain. The aggregate sunshine for the year was 1329 hours, which is twenty-two hours fewer than the average.

IN the sixth part of "Visvakarma," edited by Mr. Ananda K. Coomaraswamy, a number of interesting photographs of examples of Indian sculpture are reproduced. Perhaps the finest specimens are the elephants, a favourite study of the native artist, from Mamallapuram, on the western coast, and a remarkable bronze figure of the monkey god, Hanumán, from Ceylon, and of a mongoose from Nipal. This cheap and well-illustrated periodical furnishes valuable material for the study of Oriental sculpture.

IT is a good sign of the interest now felt among Anglo-Indian officials in local beliefs and folklore, that the *Dacca Review* has been founded for the publication of information on these subjects from eastern Bengal. Mr. H E. Stapleton, in vol. iii., No. 5, of the review, gives an interesting account of Ghazi Sahib, the patron saint of boatmen, the first Musalman invader of Sylhet. Round this worthy a mass of curious legend has collected, which deserves the attention of students of folklore and peasant religions.

IN the December issue of *Man* Prof. G. Elliot Smith revives the question of the origin of the dolmen. According to his theory, it is a degraded form of the Egyptian *mastaba*, or stone sepulchre. It is, he believes, "altogether inconceivable that the more or less crude, though none the less obvious, imitations of the essential parts of the fully-developed *mastaba*, which are seen in the Sardinian 'Giants' Tombs,' the *allées couvertes* of France and elsewhere, the widespread 'holed dolmens,' and all the multitude of 'vestigial structures,' to use a biological analogy, represented in the protean forms of the Algerian and Tunisian dolmens, could have been invented independently of the Egyptian constructions." At the two last meetings of the British Association, this view failed to command the acceptance of authorities like Profs. Boyd Dawkins and Flinders Petrie. The present exposition, though interesting and suggestive, does not deal with the more obvious objections which have been from time to time advanced in opposition to it.

MR. ROBERT MOND, who founded the Infants' Hospital, Vincent Square, S.W., in an interview reported in *The Times* of December 29, expresses a very decided opinion that infants should be fed on fresh, raw milk. He states that children thrive far better on untreated milk, that there is little risk of tuberculous infection therefrom, and that children fed on sterilised or pasteurised milk, are weak and ill-nourished and predisposed to tuberculosis. Mr. Mond has an experimental farm at Sevenoaks, at which full records and memoranda are kept, which are at the disposal of any farmer or dairyman who desires to consult them.

DR. G. MCMULLAN and Prof. K. Pearson describe, in the October (1913) issue of *Biometrika*, a pedigree of split-foot or "lobster-claw." The pedigree extends over four generations, and includes more than a hundred individuals. The deformity is always transmitted only by the affected, but appears in considerably more than half the members of affected families; for example, in the three largest families there are eight affected and none normal, six affected and four normal, five affected and four normal. The extent of the abnormality varies greatly in different cases, as is shown in the photographs with which the paper is illustrated.

EHRLICH'S well-known method of *intra vitam* staining by means of methylene-blue is proving itself extraordinarily fruitful in investigations of the nervous system of the lower animals. Adolf Gerwerzhagen has recently applied this method to the study of the nervous system of the Polyzoa, or, as some authorities prefer to call them, Bryozoa (*Zeitschrift für wissenschaftliche Zoologie*, Bd. cvii., p. 309). Students of zoology have hitherto had to content themselves with very scanty information on this subject, and will doubtless be surprised at the complexity of the nervous system now for the first time demonstrated. It appears that, in addition to the cerebral ganglion and the main nerves supplying the lophophore, &c., there is a rich network of nerve fibres and ganglion cells, not only in the body-wall of individual zooids, but extending throughout the whole colony, while the lophophore and tentacles are provided with an elaborate system of nerve fibres and sense cells, and there is also a so-called "sympathetic" system ramifying over the alimentary canal. The present communication deals with the nervous system of the well-known fresh-water form, *Cristatella mucedo*, and the remarkable coordinated creeping movements of the entire colony are rendered intelligible by the discovery of the common colonial nervous system.

IN vol. lxiv. of *Vidensk fra den naturk. Foren* Mr. H. Blegvad describes, under the name of *Leptocephalus hjorti*, the smallest leptocephalid, or eel-larva, at present known. The specimen, which was taken by the writer in the Atlantic during a voyage to the Danish West Indies in 1910–11, measures only 19·8 mm. in total length. The next smallest example taken had a length of 21·5 mm.

IN an article published in the December issue of the Museums' Journal, Mr. C. Hallett, the official guide at the British Museum, alludes to some of the difficulties connected with the work of guide-demonstrators in museums. One curious point is that, in Mr. Hallett's opinion, the majority of the visitors to the museum are drawn from the classes least fitted to appreciate its contents. Among those who form the guide-led parties, there may be a few with some knowledge of the objects under review, while there will generally be many with a little knowledge, which they desire to increase. The bane of such parties are those who are not only utterly destitute of knowledge, but have no desire to acquire any. Noise and overcrowding form other difficulties, but the gravest question to be faced is the extent (if any) to which a guide-conducted party ought to take precedence over other visitors to a museum.

THE 1914 issue of the "Live Stock Journal Almanack" fully sustains the high reputation of that publication as a trustworthy and up-to-date guide to all important matters connected with British horses, cattle, sheep, &c., during the previous year. Special interest attaches to an article by Col. Ricardo on the horse-problem, particularly in respect to Army remounts; and although there may be a shortage in horses suitable for this particular kind of work, it is satisfactory to learn from other articles that the trade in shire and other working horses was never better. In connection with cattle, reference may be made to an article on "free-martins," by Mr. C. J. Davies, in which a common misunderstanding is corrected. A "free-martin" is generally stated to be an infertile female twin calf, the fellow of which is a male; but, according to Messrs. Geddes and Thompson, such an infertile calf is really a hermaphrodite male, the fellow twin of which is a normal male. The true nature of the free-martin is revealed by its possessing the essential internal generative organs of the bull, although these are accompanied by the external accessory organs of a female, while a rudimentary vagina and uterus are also present. From the article on sheep we regret to learn that the number of head in Great Britain continues to show a serious decrease.

THREE papers on osmotic pressures in plants, by Prof. H. H. Dixon and Mr. W. R. G. Atkins, have recently appeared in the Proceedings of the Royal Dublin Society, vol. xiii. (1913). The authors show that the sap pressed from living, untreated tissues does not give a true estimate of the concentration of that in the vacuoles of the cells before the application of pressure, that in order to extract the sap from the cells without altering the concentration it is necessary to render the protoplasmic membranes permeable, and that this can best be effected by the application of liquid air. This discovery makes it necessary to revise all freezing-point and electrical conductivity determinations where expressed sap has been employed, and the authors find that their new measurements, making use of sap pressed immediately after thawing from tissues frozen solid in liquid air, give much higher osmotic pressures than had been obtained previously. An important point established is that the actual osmotic pressures in the cells are much greater than the requirements of the well-known cohesion theory of the ascent of sap in trees demand.

THE potentialities of the British egg and poultry trade are indicated in an article, by Mr. Edward Brown, in the Journal of the Agricultural Organisation Society, vol. vii., Nos. 3 and 4, 1913. Since the visit of the first egg and poultry demonstration train, three years ago, to three of the counties in South Wales the value of the local output has been increased, according to a conservative estimate, to the amount of 25,000*l*. to 30,000*l*. per annum. During April and May of last spring a similar train made a twelve days' tour in six counties in North Wales, and was visited by more than 19,000 persons. This will suffice to indicate the great interest evinced by the general public in the question, and such work, educational in itself, followed by cooperation and organisation in the marketing of produce, cannot fail to be of great value. It is, however, highly desirable that the continuation of this work should be ensured, and that adequate official support should be given instead of its being dependent on private generosity.

WE have received from the United States Geological Survey three bulletins, namely No. 522, "Portland Cement Materials and Industry in the United States," by Edwin C. Sekel; No. 527, "Ore Deposits of the Helena Mining Region, Montana," by Adolph Knapf; and No. 529, "The Enrichment of Sulphide Ores," by William Harvey Emmons. The first- and last-named of these are necessarily of more general interest than a description of a specific district can be, and whilst the first will particularly interest cement makers and engineers in general, the latter appeals most strongly to the economic geologist, and student of ore deposition. Although the bulletin upon Portland cement is intended primarily for Americans who are either "owners of lands on which marl, limestone, or clay deposits are found," or "cement manufacturers or those who desire to become such," the information conveyed will be found of great use to cement manufacturers and users all the world over, giving as it does an excellent sketch of the nature of cements and the principles of cement manufacture. As regards the bulletin by Mr. Emmons, it recapitulates in a very clear and readable form the present state of knowledge concerning the phenomena of secondary enrichment of ore deposits, paying particular attention to the chemistry of the changes involved in this enrichment; it deserves the careful attention of all mining engineers who have to deal with ore deposits liable to be affected by the phenomena here discussed.

MR. R. C. MOSSMAN has contributed to *Symons's Meteorological Magazine* for December the sixth of his interesting articles on southern hemisphere seasonal correlations. (1) Argentine Republic and Chile: The departure from the normal of the thirty-six years, 1876–1911, at certain stations show that the winter variations of temperature are generally in harmony with each other from May to August. A comparison of South American winter temperature variations with conditions in other regions yielded (with one exception) negative results. (2) Auckland, N.Z., and Alice Springs, Australia: On comparing the mean temperature at Auckland for the second quarter of the year with the values at Alice Springs for the last quarter, it was found that from 1892 to 1906 the former was an index of the latter. (3) Sydney, N.S.W., and San Francisco: From 1864 to 1889 a well-marked relation was apparent between the mean temperature at Sydney from May to August and the rainfall at San Francisco for October to April following. (4) South Orkneys and Kimberley: For the years 1903–11 the August and September temperature at the former has been a direct index of the temperature at the latter during the three months following. The temperature at the South Orkneys in August and September is largely dependent on the ice conditions of the surrounding ocean. The paper is accompanied with explanatory tables and diagrams.

MR. P. E. B. JOURDAIN'S "The Principle of Least Action" (Open Court Publishing Company, 1*s*. 6*d*.) is a reprint of three essays published in *The Monist* (1912–13). The first of these is mainly historical, and gives an abundance of quotations and references; the second deals with extensions of the theory, and alternative ways of considering the problem—in particular an outline of O. Hölder's important theory; the third paper is a critical summary. Altogether we have an interesting and impartial view of the subject, expressed in as simple a form as the nature of the topic seems to admit.

IN a pamphlet called "Principles of a New Theory of the Series," Mr. F. Tavani has given an interesting and apparently novel view of the subject. It has at any rate the advantage of making one comparatively simple test cover a large number of important cases.

We can scarcely expect more from it than this; for the test of convergence of a given series is ultimately whether s_n has a limit, s_n being the sum of the first n terms, and there is no reason to suppose that we can find, in all cases, another and more manageable way of expressing the condition of convergence. Mr. Tavani gives several important references, and has had the advantage of criticisms by Prof. M. J. M. Hill and Mr. G. H. Hardy.

Recent low-temperature research has led to results which it is difficult to reconcile with the belief that at the absolute zero of temperature the energy of the atoms and molecules of bodies vanishes. The change of the specific heat of hydrogen at very low temperatures has been shown by Prof. Einstein and Dr. Stern to be consistent with the energy of the molecules being finite at the absolute zero. Prof. Onnes and Dr. Keesom come to the same conclusion with regard to the translatory energy, and Dr. Keesom has shown that some of the difficulties of the theory of free electrons in metals are removed by the assumption of finite energy at the absolute zero. According to a recent communication from the physical laboratory of the University of Leyden, Dr. Oosterhuis finds it necessary to assume a finite energy of rotation of the molecules at the absolute zero in order to correlate his observations of the magnetic susceptibilities of a number of paramagnetic substances at very low temperatures. By this means the deviations from Curie's law of constancy of the product of susceptibility and absolute temperature are explained.

In a paper in the *Atti R. Accad. Lincei* (vol. xxii., ii., p. 390) Mr. C. Acqua shows that nuclear degeneration is produced in plant cells by traces of uranium salts. If, for example, wheat plants are grown in very dilute solutions of uranyl nitrate (1 in 10,000), the rootlets soon cease to develop, and this is accompanied by the production of a yellow colour in the nuclei of the cells of the meristem, which at the same time no longer stain in the usual manner with hæmotoxylin. The action of the uranium brings about destruction of the chromatin, and the cessation of nuclear activity. The cause of this is not yet ascertained, but it is suggested that it may be the formation of organometallic compounds or the radio-activity of the uranium itself.

The Chemical Society's Journal contains an important contribution, by Messrs. Pickard and Kenyon, to the study of optical rotatory power in homologous series. Of the series of secondary alchohols from $C_2H_5.CHOH.CH_3$ to $C_2H_5.CHOH.C_{15}H_{31}$, one is necessarily inactive, but all the others with one exception have been prepared and isolated in an optically active form. The molecular rotatory powers in this remarkable series of compounds increase fairly regularly when once the inactive diethyl carbinol $C_2H_5.CHOH.C_2H_5$ has been passed, but somewhat excessive optical activity appears in the fifth and tenth members of the series. There might be some tendency to ascribe this small excess of rotatory power to experimental error, but for the fact that when the alcohols are merely dissolved in benzene or in ethyl alcohol the curve of increasing rotatory power loses all pretence of uniformity, and develops a series of remarkable humps, which culminate at the alcohols, $C_2H_5.CHOH.C_5H_{11}$, $C_2H_5.CHOH.C_{10}H_{21}$, and perhaps $C_2H_5.CHOH.C_{15}H_{31}$. This curious behaviour is attributed to the fact that the "growing chain" of carbon atoms probably assumes a spiral form, each loop of the spiral containing *five* carbon atoms. Some indication of the same qualities has been detected in *solutions* of the methyl-carbinols, $CH_3.CHOH.R$, but the isopropyl-carbinols, $(CH_3)_2CH.CHOH.R$, behave in a perfectly regular manner, both in the homogeneous state and in solution.

We learn from *The Engineer* for January 2 that the French Minister of Public Works has requested the railway companies to submit proposals for equipping the cabs of express locomotives with audible signals as soon as possible. The Minister also points out the terrible consequences resulting from the employment of gas for lighting the coaches whenever a train is smashed in collision. He therefore orders the railway companies to hasten the substitution of electrical for gas lighting on fast trains, and he further states that he will henceforth refuse permission to the companies to purchase rolling stock equipped for gas lighting. It may be noted that British railway companies are giving attention to the automatic control of trains. Some are trying mechanical means of placing fog-signals on the line when the semaphore is at danger; others, like the Great Western and the North-Eastern, have cab signals already in use, and some are testing electrical apparatus. Many people hold that it is better to leave full responsibility with the driver, and not transfer it to a mechanism which may fail. Public opinion will, however, probably force automatic control on British railway companies.

Lecturers in colleges and teachers in schools will welcome the publication of the second part of Messrs. Newton and Co.'s catalogue of lantern slides. The volume, which is effectively bound in cloth, runs to nearly six hundred pages, and gives full particulars of the immense variety of slides which this firm is able to supply to illustrate lectures and lessons in science, nature-study, geography, history, the various industries, and other subjects. The increase in this department of their business has led Messrs. Newton and Co. to open their New Lantern Slide Gallery at 37 King Street, Covent Garden, W.C. It is worthy of note that many of the sets of slides catalogued have been compiled by such educational authorities as the Visual Instruction Committee of the Colonial Office, the Committee of London Teachers of Geography, and so on, and purchasers have the assurance that the slides are particularly suitable for educational purposes. The number of slides dealing with scientific subjects is very large, and many of them represent important pieces of research. As typical may be mentioned those from photographs of flying bullets by Prof. C. V. Boys, of sound waves by Prof. R. W. Wood, of ripples by Dr. J. H. Vincent, and of astronomical work in the Solar Physics Observatory.

OUR ASTRONOMICAL COLUMN.

TUTTLE'S NEBULA, N.G.C. 6643.—In this column for September 25 last attention was directed to M. Borrelly's observation of Hind's nebula indicating its variable nature. M. Borrelly has recently been making observations on the nebula of Tuttle, N.G.C. 6643, at the Marseilles Observatory, and has communicated the results to the *Comptes rendus* for December 22, 1913 (vol. clvii., No. 25, p. 1377). He brings together all the observations made since its discovery in 1859, and the evidence is distinctly in favour of its variability. In very recent years, *i.e.* in 1909, its light appeared to diminish considerably. From 1910 to 1912 it was feeble, but still to be seen in the comet-seeker (mag. 11). On July 10, 1913, M. Borrelly says it was scarcely visible in the instrument; on August 26 it was at the limit of visibility, while on August 27 it was practically invisible (mag. 11·5). From the observations M. Borrelly concludes that changes have taken place.

BRIGHT HYDROGEN LINES IN STELLAR SPECTRA AND P CYGNI.—Mr. Paul W. Merril communicates two papers to the Lick Observatory Bulletin, No. 246. The first is the description of a series of spectrograms of stars the spectra of which contain bright hydrogen lines, and is a continuation of the work described in the previous bulletin, No. 162 (1913). The spectra are confined to the $H\alpha$ region, and were obtained with the 36-in. refractor and a one-prism spectrograph previously described. The stars here dealt with belong to classes B and A, but stars of class Oe5 were photographed to test their relation to class B. In the last-mentioned case, although only a few stars were photographed, the evidence was negative, out of nine stars none of them indicated bright hydrogen lines. The second paper is on the spectrum of P Cygni between λ4340 and λ4650, taken with the three-prism spectrograph. Twelve photographs are discussed, having been taken between August, 1907, and September, 1913. Tables are given showing the determined displacements for numerous lines of H, He, O, N, and Si, from each of the photographs. Attention is directed to the resemblance between the hydrogen lines of P Cygni, and those of an ordinary Nova. It is stated that the measurements given in the tables show good agreement with those of Frost.

MEASUREMENT OF SMALL DISPLACEMENTS OF SPECTRUM LINES.—Bulletin No. 32 of the Kodaikanal Observatory contains an important communication by Mr. J. Evershed on a new method of measuring small displacements of spectrum lines. The main idea of the method consists in placing a positive copy of the plate to be measured reversed, and almost in contact with the negative, film to film, and moving one with reference to the other, so that the positive images are made to coincide successively with the negative images of the corresponding lines. No spider thread is used, and the accuracy of the adjustment for coincidence depends on the sensitiveness of the eye in estimating the change from the bright and dark contiguous images of a line, to the perfectly uniform density which results when the positive image exactly coincides with the negative, and the positive copy has the same gradation of tone as the negative. Mr. Evershed describes and illustrates the method and machine employed, and points out its advantages and disadvantages. He also gives two examples of measures made in the ordinary way and by the new method to show the relative accuracy obtained; these represent two series of solar rotation plates. The results indicate that the probable error is about halved in the positive on negative measures as compared with the ordinary measures, and the gain in accuracy is about the same whatever way the probable errors are estimated.

ASTRONOMICAL ANNUALS AND STAR CHARTS.—The annual "Companion to The Observatory" has nearly become standardised in form, and the present issue will be found as useful as ever. The favourable and accessible total eclipse of the sun on August 20–21 next calls for extra information, and this has been given in the form of the sun's altitude, azimuth, and parallactic angle for the more accessible part of the line of totality in addition to the usual data. For the fiftieth year the handy astronomical and meteorological annual, edited by M. Camille Flammarion, makes its appearance, and the great amount of interesting matter contained within its covers is as complete and useful as in previous issues. Space does not allow one to enter into any detail regarding the wide range of the information here brought together, but astronomical readers are sufficiently acquainted with previous volumes to know the utility of the information displayed. As is usual, a number of excellent illustrations and figures accompany the text. Mrs. H. Periam Hawkins's "Star Almanac for 1914" and "Revolving Star Map" will be found very useful to astronomers generally. The former consists of a large sheet to be hung up on a wall, and contains much useful matter relative to the apparent stellar movements, meteor showers, planets, &c. The latter is a well-constructed planisphere for stars seen from the northern hemisphere, and has a movable declination scale.

PRIZE SUBJECTS PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1915.

Geometry.—Francœur prize (1000 francs), for discoveries or works useful to the progress of pure or applied mathematics; Bordin prize (3000 francs), to make notable progress in the study of curves with constant torsion; to determine, if possible, which of these curves are algebraic, at least those which are unicursal.

Mechanics.—A Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts or science; Poncelet prize (2000 francs), for work on applied mathematics; Boileau prize (1300 francs), for researches on the motion of fluids contributing to the progress of hydraulics.

Navigation.—The extraordinary prize of 6000 francs for work leading to increased efficiency of the French naval forces; Plumey prize (4000 francs), for improvements in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—Pierre Guzman prize (100,000 francs), to anyone finding a means of communication with another planet other than Mars. Failing the above, the accumulated interest of five years will be awarded for an important astronomical discovery. Lalande prize (540 francs), for memoir or work useful to the progress of astronomy; Valz prize (460 francs), to the author of the most interesting astronomical observation during the year; G. de Pontécoulant prize (700 francs), for researches in celestial mechanics.

Geography.—Tchihatchef prize (3000 francs), as recompense or encouragement to naturalists of any nationality distinguished in the exploration of the lesser-known parts of Asia; Gay prize (1500 francs), for a study of the distribution of plants in Indo-China.

Physics.—Hébert prize (1000 francs), for a treatise or discovery in connection with the practical use of electricity; Hughes prize (2500 francs), for discoveries or works contributing to the progress of physics; Henri de Parville prize (1500 francs), for original work in physics; Gaston Planté prize (3000 francs), for the French author of an important discovery, invention, or work in the field of electricity.

Chemistry.—Jecker prize (10,000 francs), for work conducing to the progress of organic chemistry; Cahours prize (3000 francs), for the encouragement of young chemists; Montyon prize (unhealthy trades; one prize, 2500 francs, a mention of 1500 francs), for the discovery of a means of rendering an art or trade less unhealthy; Houzeau prize (700 francs), for a young chemist.

Mineralogy and Geology.—Delesse prize (1400 francs), for work in geology, or, failing that, in mineralogy; Joseph Labbé prize (1000 francs), for geological researches contributing to the development of the mineral wealth of France, its colonies, and protectorates.

Botany.—Desmazières prize (1600 francs), for the best publication during the year on Cryptogams; Montagne prize (1500 francs), for work on the anatomy, physiology, development, or description of the lower Cryptogams; de Coincy prize (900 francs), for a work on phanerogams; Thore prize (200 francs), for work on the cellular cryptogams of Europe; Jean de Rufz de Lavison prize (500 francs), for work on plant physiology.

Anatomy and Zoology.—Savigny prize (1500 francs), for the assistance of young travelling zoologists, not receiving Government assistance, who work on the invertebrates of Egypt and Syria; Cuvier prize (1500 francs), for work in zoological palæontology, comparative anatomy, or zoology; da Gama Machado prize (1200 francs), for memoirs on the coloured parts of the tegumentary system of animals.

Medicine and Surgery.—Montyon prize (2500 francs, mentions of 1500 francs), for discoveries or inventions in medicine and surgery; Barbier prize (2000 francs), for a discovery in botany in relation to medicine, or in the sciences of surgery, medicine, or pharmacy; Bréant prize (100,000 francs), for a specific cure for Asiatic cholera; Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; Baron Lorrey prize (750 francs), for a work treating of military hygiene, medicine, or surgery; Bellion prize (1400 francs), for medical discoveries; Mège prize (10,000 francs); Argut prize (1200 francs), for the discovery of a remedy for a disease at present not capable of treatment; Chaussier prize (10,000 francs), for the best book or memoir published during the last four years on legal or practical medicine; Dusgate prize (2500 francs), for a work on the signs of death and the means of preventing premature burial.

Physiology.—Montyon prize (750 francs), for work in experimental physiology; Philipeaux prize (900 francs), for experimental physiology; Lallemand prize (1800 francs), for work relating to the nervous system; Pourat prize (1000 francs), for a memoir on the relations between the combined sugar of the blood and the albuminoid materials.

Statistics.—Montyon prize (1000 francs, and two mentions of 500 francs), for works dealing with statistical questions.

History of Science.—Binoux prize (2000 francs).

General Prizes.—Arago medal; Lavoisier medal, for work in chemistry; Berthelot medal, to persons taking prizes in chemistry or physics; Henri Becquerel prize (3000 francs); Gegner prize (3800 francs); Lannelongue prize (2000 francs); Gustave Roux prize (1000 francs), Tremont prize (1100 francs); Wilde prize (4000 francs), for a work or discovery in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; Lonchampt prize (4000 francs); Saintour prize (3000 francs), for work in mathematics; Henri de Parville prize (2500 francs); Victor Raulin prize (1500 francs), for facilitating the publication of works relating to geology and palæontology; Vaillant prize (4000 francs), for the discovery of a photographic plate free from grain, and as sensitive as the gelatino-bromide in current use; Fanny Emden prize (3000 francs), for work dealing with hypnotism and suggestion; Grand prize of the physical sciences (300 francs), for the study of a French colony from the point of view of its geology, mineralogy, and its physical geography; Leconte prize (50,000 francs), for new and important discoveries in mathematics, physics, chemistry, natural history, and medical science; Petit d'Ormoy prize (10,000 francs), for work in pure or applied mathematics or in natural science; Pierson-Perrin prize (5000 francs), for a discovery in the field of mechanics or physics.

THE ASSOCIATION OF ECONOMIC BIOLOGISTS.

The twelfth annual Congress of the Association of Economic Biologists, held at the Liverpool School of Tropical Medicine, last week, marked off a distinct era in the progress and development of economic biology in the United Kingdom.

Founded in November, 1904, with a membership of twenty-four, it seemed doubtful for a time whether what Prof. Fred V. Theobald aptly christened "Mr. Collinge's healthy infant," would weather the storms of its early days. At that time economic biology was looked askance at in all our universities, and regarded as something ultra-scientific, and could only be said to be taught and studied in any detail at the South-Eastern Agricultural College, Wye.

Even at a later date professors of biology were interested only in the morphological or systematical aspects of biology, and dreaded the intrusion of applied biology. Happily these views have all passed away, and the association may very rightly claim to have had a large share in bringing about a more reasonable and truly scientific spirit.

Meeting first in the University of Birmingham, the association has held meetings in the Universities of Liverpool, Cambridge, London, Edinburgh, Oxford, Manchester, and Dublin. From each of these centres of learning it has gathered strength, leaving behind some record of the really valuable work which its members have been engaged upon, and indirectly tending to gain the sympathies of those who originally regarded the organisation from an entirely mistaken point of view. Gradually biologists in this country were beginning to realise that, as stated by Prof. Miall, "a practical purpose is, in my opinion, not a hindrance but a powerful motive to the acquisition of scientific knowledge. If not too narrowly prosecuted, the practical purpose may be a means of distinguishing knowledge, which is really useful from knowledge which is merely curious."

Since 1904 departments of economic biology have been founded in nearly all our universities, which has meant an increase in the number of workers, and has made the association still more necessary for such investigators to possess an organisation wherein they could "discuss new discoveries, exchange experiences, carefully consider the best methods of work, give opportunity to individual workers of announcing proposed investigations, so as to bring out suggestions and prevent unnecessary duplication of work, and to suggest, when possible, certain lines of investigation upon subjects of general interest."

The outstanding feature of the Liverpool meeting was the decision of the council to increase the number of meetings to four per annum, three of which will be held in London, and one in the provinces; coupled with this it was gratifying to note the large number of new members, particularly so of those working in connection with the Board of Agriculture and Fisheries, and in the newly established university departments.

It is hoped that with the increase in the number of meetings there will be a still further increase in the membership, and that the association will take its position amongst the numerous other learned societies, thoroughly representative of all branches of applied biology.

To a very much larger extent than hitherto, the association will in the future play no unimportant part in defining the scope of economic studies in biology, and having now definitely taken up its headquarters in London, it will be more in touch with Governmental departments. Representative as its membership is of the universities of the country, and not a few of our Colonial departments, the possibilities that lie before it are endless, and should exercise a very profound influence upon the future of economic biology in this country, tending to raise its status to the level it occupies in other countries, and to become still more beneficial to the people of this country and its great Colonial Empire. W. E. C.

FATIGUE AND EDUCATIONAL WORK.

THE London County Council's annual Conference of Teachers, held last week, yielded some notable pronouncements. On the opening day, January 1, Canon Masterman laid stress upon the training in morals and in imagination which pupils gain when history is properly taught. History provides an education in sympathy not only with our forefathers, but with "the brotherhood that binds the brave of all the earth." The true historian always cares supremely for the truth; the critical faculty of the pupil must be carefully trained. To the great deed they must offer their admiration, their gratitude if they could, and, if not, then their silence. The historian differs from the antiquary in his constant thought of the present; the boy who rides in imagination with the knight to the *Parliamentum* at Westminster will have a clearer idea of the responsibility of citizenship. The pageantry of history is sacramental; it has an inward and spiritual import, and, unless the teacher feel something of the spiritual significance of history, he had better teach algebra or mechanics all his life.

On the second day, Mr. W. H. Winch gave the results which had attended a few experiments he had made in testing the fatigue of adolescents who were in attendance at evening continuation schools. He pointed out that his experiments in connection with the fatigue of day-school pupils had yielded no satisfactory result, while he had found distinct evidence of fatigue in adolescents who continued their education in the evenings. His experiments indicate that, in the cases he examined, adolescent students suffered a loss of ability as the period of instruction drew to a close. He instanced six sets of experiments, and in the only case which did not show the results of fatigue subsequent inquiry showed that 75 per cent. of the students were not occupied during the daytime. From such evidence he concluded that evening continuation schools were not places of serious continued education for adolescents; they were a waste of educational appliances. The chairman, Dr. W. McDougall, Wilde reader in mental philosophy, thought these conclusions somewhat premature, as it did not follow that work which caused a measurable amount of fatigue was work which should, therefore, not have been undertaken.

Mr. T. H. Pear described an experiment in connection with the fatigue which ensues from loss of sleep in which it was demonstrated that the fatigue persisted long after the subject was of opinion that the effects of the lack of sleep had disappeared. He suggested that, on account of fatigue, the teacher who energetically changed from a strenuous lesson on one subject to a lesson of equal strain on another subject lost efficiency; the early lesson caused fatigue, and should have been followed by a period for recuperation.

The conference closed with a description of six educational experiments; it was announced, as evidence of the wide latitude for experiment allowed in the elementary schools, that no fewer than sixty descriptions of such experiments had been offered for the consideration of the conference.

ENGINEERING AT THE BRITISH ASSOCIATION.

THE Engineering Section of the British Association met under the presidency of Prof. Gisbert Kapp, who took for the subject of his address the electrification of railways. The address, which was printed in full in NATURE of October 9 (p. 184), was followed by an interim report of the committee on gaseous explosions, which very briefly chronicled the work accomplished during the year, and described the steps which are being taken to carry on further research work at the Imperial College of Science. One of the notes presented to this committee was also read by the authors, Profs. Petavel and Asakawa, and described some experiments on the effect upon gas-engine efficiency of varying compression ratio. In these experiments the brake-horse-power increased in the same proportion as the theoretical air efficiency, but the mechanical efficiency decreased as the compression ratio increased.

The concluding paper of the first meeting was read by Prof. Burstall on solid, liquid, and gaseous fuel, in which he discussed the various advantages obtained from each kind of fuel, and outlined a scheme for utilising, to the best advantage, a large daily supply of coal at the pit mouth by the production of coke, fuel gas, sulphate of ammonia, and various by-products of the tar obtained from the retorts.

The first paper on the Friday morning dealt with the application of the internal-combustion engine to railway locomotion, and described a bogie-coach of 60 ft. in length propelled by two six-cylinder Daimler engines through the medium of gears affording six-speed ratios. Recent trials demonstrate the feasibility of maintaining a high speed over long distances at a reasonable cost, and the author, Mr. F. W. Lanchester, advocated the running of such vehicles on main lines at frequent intervals as much more economical and satisfactory than a service of long trains at considerable intervals. In the paper which followed, Dr. Hele-Shaw described a new type of hydraulic weighing-machine of the piston type, in which packings are dispensed with, while friction and leakage are practically eliminated by ingenious mechanical devices.

The propulsion of barges on canals by aërial propellers was described by Mr. L. B. Desbleds, and although the possible efficiency of this system of propulsion was shown to be very small, the author considered there was a limited field for its application in cases where submerged propellers could not be employed.

Mr. Lanchester directed attention to the various factors which cause instability in aëroplanes, and with the aid of models demonstrated the important features which are necessary to consider in the design of a stable aëroplane, especially as regards the tail-plane.

The cost of electric cooking was discussed by Prof. Morris, with reference to the result of one year's working in a flat within the London area. A paper by Mr. A. E. Bawtree on bank-note engraving was illustrated by a number of photographs describing various methods in general use for the prevention of forgery. The author showed examples of a new system of a geometrical character, which cannot be imitated by repetition work, or by mechanical devices such as the pantagraph. The system which was not described was stated to allow the incorporation of a design which could only be made visible by a special screen. The concluding paper at this meeting was read by Mr. C. H. Lander on the frictional loss in steam pipes, and described experiments which agree with a dimensional formula due to Osborne Reynolds.

A joint meeting of Sections A and G took place on the Monday morning to discuss the report of the committee, appointed last year, to consider certain of the more complex stress distributions in engineering materials. The principal results of modern investigations on combined stress were discussed by Mr. W. A. Scoble, while alternating stress was similarly dealt with by Messrs. Mason, Rogers, and Eden, and a special report on the resistance of tubes to collapse was contributed by Mr. G. Cook. The discussion upon the report was opened by Prof. Perry, the chairman of the committee, who urged the importance of coming to a definite agreement as to the criterion of failure in a material subjected to stress. The discussion on the various sections was continued by Mr. Stoney and other engineers, and covered a wide range of subjects connected with the experimental investigation of stress distribution in engineering materials.

A Section A paper by Prof. Coker was, for the convenience of the meeting, read immediately after the termination of the joint discussion; it described the construction of polariscopes for examining the stress distribution in large models of engineering structures built up of transparent materials. A second paper by the same author described the preliminary results of an investigation upon the stress distribution in rings subjected to internal or external pressure, with apparatus which leaves every part of the ring free for measurement except the surface exposed to fluid pressure.

A paper contributed by Mr. T. Reid, described some experiments on the flow of solids based on the well-known experiments of Tresca. Lead cylinders divided in halves by a diametral plane are grooved to receive tin wires, which latter serve to map out the flow produced when pressure is applied to the cylinders. The experimental results appear to show that a very slow flow is stable, and that above a certain limit there is a condition resembling turbulence in a fluid.

A paper by Mr. A. Robertson described experiments on the strength of free-ended struts, in which Euler's formula is shown to hold good down to the length for which the stress given by this law is equal to the stress at yield, and, below this limit collapse occurs, when the load per square inch is equal to the yield stress. A concluding paper by Mr. A. T. Walmisley described the properties of non-ferrous metals which are of importance in structural engineering.

On the Tuesday morning the first paper on an engineering theory of the gyroscope was read by Mr. J. W. Gordon, who pointed out that when a gyroscope is precessing freely it is absorbing power, while in forced precession it is transmitting. By the application of suitable constraining devices many important practical instruments can be constructed, of small size, for the steering of ships, the prevention of rolling and pitching of aëroplanes, and the like. A short note by Prof. Wilson on tests of metals and alloys, directed especial attention to the increased brittleness and rise of electrical resistance of duralumin on prolonged exposure to the atmosphere.

Papers dealing with various matters connected with wireless telegraphy were also read by Prof. Howe, who described the nature of the electromagnetic waves employed in radio-telegraphy, and the mode of their propagation. Dr. Eccles discussed atmospheric refraction and absorption as affecting transmission, and Prof. Marchant, the effect of atmospheric conditions on the strength of signals received at Liverpool from Paris and other wireless stations of great power. The final paper on Tuesday morning was read by Mr. W. R. Cooper, and described some practical suggestions for shortening the tests of temperature rise in electrical machines under working loads.

As in previous years, a meeting on the Wednesday was necessary for the consideration of several important papers, and a programme on civil engineering subjects was followed with much interest by a large audience. Dr. Vaughan Cornish described the landslides in the Culebra Cutting of the Panama Canal, especially those in which subsidence of the banks has caused numerous upheavals of the canal bottom.

A paper on the reconstruction of the station at Snow Hill, Birmingham, was read by Messrs. Gleadow and Shackle, in which the structural steel work was very fully described. The effect of harbour projections was discussed by Mr E. R. Matthews, and he advocated the use of piers inclined at such an angle to the shore that moving sand and shingle tends to sweep past the end of the pier and settle on the lee side. The transport and settlement of sand in water was also described, with many experimental illustrations, by Dr. J. S. Owens. An apparatus was also exhibited for exploring sand bars and river beds. It consisted of two concentric tubes closed above and open below, and provided with stop-cocks so that water under pressure can be forced through the inner tube to sink the apparatus in the sand or other material. When the desired level is reached a stop-cock communicating with the annular space is opened to allow a return passage for the water under pressure, and this carries with it a sample of the material at the base of the apparatus, and delivers it at the outlet.

These interesting experiments concluded a very successful programme of the Engineering Section at the Birmingham Meeting.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Bristol.—The degree of D.Sc. in engineering will be conferred on Mr. Charles F. Smith, who has submitted to the University records of his research work and publications in connection with electrical engineering.

London.—The degree of doctor of science in chemistry has been conferred upon Mr. F. G. Pope, an external student, of East London College. In addition to a thesis entitled, "The Fluorine Group," Mr. Pope submitted a list of printed contributions to the advancement of science, published independently or conjointly.

The degree of doctor of science in geology has been conferred upon Mr. E. H. Pascoe, external student, of University College. Mr. Pascoe presented a published thesis entitled, "The Oil Fields of Burma," together with some further contributions to the advancement of of science, published independently.

The following lectures to advanced students of the University, and to others interested in the subjects dealt with, are to be given. Admission is free, without ticket:—Eight lectures on recent studies on the phenomena of soil fertility, Royal College of Science, Dr. E. J. Russell, on Wednesdays, beginning on January 28. Five lectures on the Devonian flora, University College, Dr. D. H. Scott, F.R.S., on Wednesdays, beginning on May 6. Two lectures on plant pigments, University College, probably on May 4 and 5, Dr. R. Willstätter, professor of chemistry in the University of Berlin. Two lectures on "La catalyse, et mes divers travaux sur la catalyse," King's College, probably on May 14 and 15, Prof. Paul Sabatier, of the University of Toulouse. Four lectures on the theory of wave-motion, with special reference to earthquake waves, the University, Dr. Horace Lamb, F.R.S., on Fridays, February 20, 27, March 6 and 13 Nine lectures on the theory of heat in relation to atmospheric changes, the Meteorological Office, South Kensington, Dr. W. N. Shaw, F.R.S., on Fridays, beginning on January 23. The fortnightly meetings at the Meteorological Office for discussion of important contributions to meteorology, chiefly in Colonial or foreign journals, will be resumed on Monday, January 19, and will be continued on alternate Mondays until March 30. Four advanced lectures in physics will be given during the third term by M. Jean Perrin, professor of physical chemistry at the Sorbonne. Further particulars will be published at a later date. Four lectures on carbohydrate fermentation, King's College, Dr. A. Harden, F.R.S., on Mondays, January 26, February 2, 9, and 16. Eight lectures on physiological effects of anæsthetics and narcotics, Guy's Hospital, Dr. M. S. Pembrey and J. H. Ryffel, on Thursdays, January 22, 29, February 5, 12, 19, 26, March 5 and 12. Twelve lectures on the Protozoa parasitic in man, the Lister Institute, Prof. E. A. Minchin, F.R.S., on Tuesdays and Fridays during the second term, beginning on Tuesday, January 27. Eight or nine University lectures on anaphylaxis, King's College, department of bacteriology, Dr. L. Rajchman, on Thursdays, beginning on January 15. Three lectures on the place of instinct in evolution," Prof. C. Lloyd Morgan, F.R.S., have been arranged for the second term. During the third term a course of three lectures on the morphology of the cranial muscles in vertebrates will be given by Prof. F. H. Edgeworth. A course of lectures on the Assouan Dam will be given by Mr. J. S. Wilson, on Wednesdays during March.

A lecture, open to the public, on the æther of space, will be given by Sir Oliver Lodge, F.R.S., at Bedford College, on Tuesday January 27. Other free lectures at the college are:—January 22, "Minerals Used as Gem Stones," Dr. C. A. Raisin; February 5, "The Optical Characters of Minerals," Dr. A. Hutchinson; February 19, "Corundum and Spinel," H. H. Thomas; January 19, "Geology of the British Isles," Dr. C. A. Raisin.

Mr. H. J. Crawford, formerly principal clerk for higher education under the Glamorgan County Council, has been appointed secretary to the Appointments Board of the University of London in succession to Dr. A. D. Denning.

MR. J. C. JOHNSON has been appointed to the chair of general biology, botany, and zoology at Auckland University College, in succession to Prof. A. P. W. Thomas, who recently resigned.

BY the will of the late Miss Emily M. Easton, who died a few days ago, a legacy of 10,000*l*. is bequeathed to the Durham College of Medicine, Newcastle, and one of 5000*l*. to Armstrong College.

THERE is much interesting reading in the December issue of the *Reading University College Review*. The principal of the college, Mr. W. M. Childs, contributes an obituary notice of the late Mr. George W. Palmer, to whose munificent generosity the college owes much of its success. The college lecturer in geology writes on the charm of palæontology, and the college lecturer in education and master of method on an outdoor school. The leading article deals with the University library, and has already been referred to in these columns.

THE general meeting of the Association of Public School Science Masters will be held at the Imperial College of Science and Technology, South Kensington, on Tuesday and Wednesday, January 13 and 14. The president, Prof. H. B. Baker, F.R.S., will deliver an address, and the following papers will be read and discussed:—"Agricultural Experiments in Public Schools," H. O. Hale; "Present Conditions of Science Teaching in Public Schools," E. H. Tripp, G. H. Martin, and J. R. Eccles; "The Place of Acoustics in a School Course of Physics," D. Rintoul; and "The Relative Value of Physics, Chemistry, and Biology," H. A. Wootton.

THE sixth annual dinner of old students of the Royal College of Science, London, will be held at the Criterion Restaurant, Piccadilly Circus, W., on Saturday, January 31, 1914. The president of the Old Students Association (Dr. A. E. H. Tutton, F.R.S.) will preside, and the guests will include Mrs. Ayrton, Prof. W. Bateson, F.R.S., Sir John Rose Bradford, K.C.M.G., F.R.S., Dr. H. Frank Heath, C.B., Dr. W. P. Herringham, Sir Alfred Keogh, K.C.B., Sir William Ramsay, K.C.B., F.R.S., and Sir Amherst Selby-Bigge, K.C.B. Tickets may be obtained on application to the secretary of the association, 3 Selwood Place, S.W.

AN international kinematograph exhibition and conference will take place in the Zoo Buildings, Glasgow, on February 17–26, 1914, and will be opened by the Lord Provost. Special films will be shown dealing with natural history, medicine, industries, travel, geography, and an entirely new series will deal with a complete survey of the British Isles. Conferences will be held dealing with secular and religious education, emigration, and business. In connection with the education conferences an advisory committee has been formed consisting of prominent Scottish educationists and representatives of school boards and educational associations. All communications and inquiries should be addressed to Mr. H. D. Cotton, 140 West George Street, Glasgow.

THE prime necessity that adolescents should be encouraged to continue their education beyond the stage represented by the primary school was abundantly illustrated at the great public meeting of employers inaugurated by the London County Council, and held on January 5, at the Mansion House. Very many firms had expressed their support of the proposal that employers should aid the council in obtaining the best results from the reorganised system of evening institutes established this year in London, and many prominent business men supported the principal speakers, Mr. J. A. Pease, President of the Board of Education, and Lord Salisbury, by their presence on the platform. There was no lack of evidence that the old scheme of evening schools was inefficient, since but 25 per cent. of the possible students enrolled, and 33 per cent. of the actual students attended badly; and it was demonstrated that wherever employers had given facilities for their young people to acquire additional knowledge under a scheme which allowed the students time for study in working hours without loss of wages, there had been keenness and improved efficiency among the staff. Mr. Pease pointed out that the problem was of national importance, and that while there might be immediate loss to the employers there would be ultimate gain not only for the employers and the employees, but for the nation at large. He suggested that no employment was beneficial that did not allow reasonable time off for continued education, and charged the business community with the responsibility of a national duty to effect some improvement, which he was sure the London County Council would facilitate.

THE annual report of President Butler on the work of Columbia University, New York, for the year ending June 30, 1913, has now been published. We find that during the year the sum of 123,600*l.* was given to the University to establish permanent funds or to add to existing resources; 67,500*l.* to purchase land or to erect and equip buildings, and 93,300l. to be expended for specific purposes, making a total of 284,400*l.*; and yet President Butler says "it is still necessary to repeat words that were used eleven years ago: 'Columbia University as now organised and equipped, may be likened to a giant in bonds. Strength, power, zeal for service, are all at hand, but the bonds of insufficient funds hold them in on every side.'" The unparalleled growth and expansion of the University have far more than kept pace with the new resources that have been provided. The enrolment of students as compared with that for the year 1911–12 shows an increase of 1016, the net total of regular students in every subject reaching 9379. If to the regular students be added those receiving extension teaching and those studying in evening technical classes, the grand total receiving instruction is 13,120. The teaching staff in 1913 numbered 847, as compared with 781 in 1912. President Butler, commenting on these very large numbers, says:—We should deplore growth in numbers unless it were accompanied by a steady increase in the quality of the students. The fact that a rigid examination is insisted upon for admission . . . and that all credentials offered by those who seek advanced standing or who wish to enter the graduate and professional schools are subjected to the closest scrutiny, and the further fact that no student is allowed to shirk his work and to remain long upon the rolls of the University, are an indication of the spirit with which the several faculties, administrative boards, and administrative officers view their responsibilities."

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, December 17, 1913.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—C. **Dawson** and Dr. A. Smith **Woodward**, with an appendix by Prof. G. Elliot **Smith**: Supplementary note on the discovery of a Palæolithic human skull and mandible at Piltdown (Sussex). The gravel at Piltdown (Sussex) below the surface-soil is divided into three distinct beds. The first, or uppermost, contains subangular flints and "eoliths," and one palæolith was discovered there *in situ*. The second is a very dark bed, composed of ironstone and subangular flints. All the fossils so far found in the pit have been discovered in, or traced to, this bed, with the exception of the remains of deer. A cast of a Chalk fossil, *Echinocorys vulgaris*, from the zone of *Micraster cor-testudinarium*, occurred as a pebble. The third bed was recognised only in 1913, and consists of reconstructed material from the underlying Wealden rock (Hastings Series). It is only about 8 in. thick, and contains very big flints (8 to 15 in. long) which have been little rolled, and are not striated. They are saturated with iron, and have undergone considerable chemical change. They differ very markedly in appearance from the smaller flints in the upper strata. No implements, "eoliths," or fossil bones have been met with in this bed. The floor of the gravel, where the remains of Eoanthropus were discovered, has been carefully exposed, and many irregularities and depressions have been found to exist. In some of these depressions small patches of the dark overlying bed remained, and new specimens were discovered. The method adopted in excavation is described. The finds made in 1913 are few but important, and include the nasal bones, and a canine tooth of Eoanthropus discovered by Father P. Teilhard de Chardin; also a fragment of a molar of Stegodon and another of Rhinoceros; an incisor and broken ramus of Beaver (*Castor fiber*); a worked flint from the dark bed; and a Palæolithic implement from the débris in the pit. It will be noted that the remains are those of a land fauna only. The further occurrence of bedded flint-bearing gravels in the vicinity of the pit is noted. The authors' former conclusions, as to the Pliocene forms having been derived, are maintained. A further study of the cranium of Eoanthropus shows that the occipital and right parietal bones need slight readjustment in the reconstruction, but the result does not alter essentially any of the conclusions already published. The nasal bones, now described, are typically human, but relatively small and broad, resembling those of some of the existing Melanesian and African races.—In a note appended to the paper Prof. Elliot **Smith** points out that the presence of the anterior extremity of the sagittal suture, which hitherto had escaped attention, had enabled him to identify a ridge upon the cranial aspect of the frontal bone as the metopic crest, and thus to determine beyond all question the true median plane. It is 21 mm. from the point of the large fragment (in the frontal region). The backward prolongation of the frontal median crest cuts the parietal fragment precisely along the line determined by Dr. Smith Woodward on other grounds.

Institution of Mining and Metallurgy, December 18.—Mr. Bedford McNeill, president, in the chair.—C. O. **Bannister** and G. **Patchin**: Cupellation experiments: a simple method for the detection of the platinum metals in cupellation beads. Following up previous investigations, the authors presented in this paper, and by means of a series of fine lantern slides, illustrations of the method they submit for the detection of platinum and its kindred metals in cupellation beads composed of gold and/or silver. The method consists in transferring the beads, after cooling, and without any squeezing, hammering, or brushing, direct from the cupel on to a plasticine mount attached to a microscopic slide, and examining it with a low-power objective, with vertical illumination preferably. This method possesses the marked advantage that no preparation of the bead by polishing, etching, &c., is necessary before examination, the only precaution advisable being the prevention of undue spitting. The results of the authors' investigations and experiments with gold and silver beads containing varying quantities of platinum, iridium, rhodium, ruthenium, and palladium were to show that, by a simple microscopic examination it is possible to detect platinum in cupellation beads when present below 1·6 per cent.; that is to say, when present below the amount necessary to cause crystallisation visible to the naked eye; the presence of iridium in small quantities may be detected in silver beads; that rhodium and ruthenium may also be detected by visual examination; that palladium, whilst producing a structure similar to that caused by the presence of platinum, yields evidence of its presence by the coloration of the parting acid. No specific indications were obtained of the presence of osmium, but the presence of osmiridium was shown to give results closely approximating to those obtained from the presence of iridium alone.—G. Maitland **Edwards**: Notes on mines of the Ottoman Empire. In this paper the author gives a brief review of the mineral resources of Asia Minor, dealing respectively with coal, iron, chrome and emery, lead, zinc, silver, nickel, gold, mercury, borax, magnesia, phosphates, guano, salt, petroleum, and other deposits. He also furnishes a brief review of the laws governing mining enterprise in the empire, and of the economic and transportation facilities.

Linnean Society, December 18.—Prof. E. B. Poulton, F.R.S., president, in the chair.—J. **Parkin**: The evolution of the inflorescence. The author stated that the evolution of all types of inflorescences is to be traced from the solitary terminal flower; and he indicated the order of development.—C. E. **Salmon**: *Hypericum desetangsii*, Lamotte, in Britain. In 1893 the late Mr. T. Hilton, of Brighton, collected what he considered to be *H. dubium*, Leers, in the vicinity of Lewes. Some years after, the specimen came into the author's hands and was seen not to be the usual plant so named. Various causes prevented him from visiting the locality at the proper season until the present year, when good examples were examined on the spot and afterwards more minutely at home. It appears that the Lewes plant must be placed under the species published by Lamotte (in Bull. Soc. Bot. Fr., vol. xxi., p. 121) in 1874, as *H. desetangsii*, and further elaborated, in the same journal, by Bonnet in 1878. It may be roughly distinguished from *H. perforatum*—of which it has the golden yellow flowers—by its four-angled stem; from *H. tetrapterum* by the colour and size of its flowers, and from *H. quadrangulum* (*H. dubium*) by its dotted leaves and narrower sepals. These are main distinctions; finer ones exist.

Manchester.

Literary and Philosophical Society, December 2.—Prof. F. E. Weiss, vice-president, in the chair.—Prof. E. **Rutherford**: The structure of the atom. The author two years ago described a new type of atom—the "nucleus" atom—supposed to consist of a central nucleus, probably charged positively, of very minute dimensions, in which practically all the mass of the atom was concentrated. This was surrounded by a distribution of negative electrons sufficient to make the atom electrically neutral. This type was devised to explain the fact that the swift α particles in traversing matter are occasionally deflected through more than a right angle as the result of a single encounter with another atom. It was deduced that the number of electrons and consequently the charge on the nucleus was numerically equal to about half the atomic weight. Experiments since carried out by Geiger and Marsden have shown that the large angle scattering of α particles is in very close agreement with this assumption of the atom's constitution, and they showed, in particular, that the variation of the number of α particles scattered through different angles by different elements agreed closely with the theory over a range in number of nearly one million times. The deflection of the α particle is due to its passage close to the intense field of the nucleus. In his experiments with hydrogen, Mr. Marsden has found definite evidence that some of the hydrogen atoms actually acquire such a great velocity by their encounters with α particles that they are able to travel through hydrogen at least three times the distance of the α particle itself through the same gas. On the nucleus theory it is supposed that the hydrogen atom contains one positive charge and the helium two. The author discussed the dimensions of the bodies in question, and the probable distance apart of the nucleii at the moment of repulsion. It was pointed out that the chemical and physical properties of the atom are ultimately determined by the charge on the nucleus, which should consequently be a more fundamental constant than the atomic weight. The latter will depend on the inner structure of the nucleus, and may not be proportional to the charge on the nucleus.

December 16.—Mr. F. Nicholson, president, in the chair.—R. L. **Taylor**: The action of bleaching agents on various natural colouring matters. In estimating the bleaching power of the ordinary bleaching agents the kind of colouring matter has to be taken into consideration. Colouring matters such as indigo and turkey-red are quickly and completely bleached by chlorine or hypochlorous acid. In ordinary unbleached linen, cotton, and jute, there appear to be two quite different kinds of colouring matter, one rapidly bleached by chlorine and hypochlorous acid, while the other is quite unaffected by these bleaching agents, but is bleached by a solution of a hypochlorite containing little, if any, free alkali. A considerable amount of the colouring matter in linen and jute is not affected by chlorine or hypochlorous acid, but in cotton the proportion unbleached by these agents is very small indeed. However, cotton is not completely bleached by either bleaching agent even after prolonged exposure to one of them.

Paris.

Academy of Sciences, December 29, 1913.—M. P. Appell in the chair.—Paul **Sabatier** and M. **Murat**: Contributions to the study of benzhydrol: the preparation of symmetrical tetraphenylethane. The reaction between benzaldehyde and phenylmagnesium bromide gives a very poor yield of benzhydrol, under 3 per cent., diphenylmethane and symmetrical tetraphenylmethane being produced by secondary reactions. The interaction of hydrogen and tetraphenylmethane in presence of reduced nickel at 230° C. gives diphenylmethane and di*cyclo*hexylmethane.—M. de **Grossouvre** was elected a correspondant for the section of mineralogy in the place of M. Depéret, elected non-resident member.—Ernest **Esclangon**: Observations of the Delavan comet made with the large equatorial of the Bordeaux Observatory. Data given for December 22 and 23.—F. **Ollive**: The solar system.—Luc **Picart**: The calculation of a circular orbit with the aid of a single photographic observation.—A. **Demoulin**: The resolution of a problem of the integral calculus.—Léon **Lichtenstein**: Integration of the equation $\Delta_2 u = ke^u$ on a closed surface.—Georges **Giraud**: A group of birational transformations.—Alfred **Rosenblatt**: The invariants of algebraical varieties in three dimensions.—Jules **Drach**: The integrals common to several problems of mechanics.—A. **Cotton**, H. **Mouton**, and P. **Drapier**: The influence of the size of the particles on the electro-optical and magneto-optical properties of a mixed liquid. The conclusions arrived at theoretically by Pockels are shown to be confirmed by experiment.—Jean **Pougnet**, Emile **Segol**, and Joseph **Segol**: The variation of the electromotive force of a Weston cell under the influence of ultraviolet light. Light of short wave-length causes a progressive lowering of the E.M.F. of a Weston cell. Removed from the radiation, the cell slowly returns to its original E.M.F. The change observed was 0·007 volt.—A. **Recoura**: Chromium fluosilicate and its transformations.—F. **Bourion** and A. **Sénéchal**: The estimation of chromium by oxidation in alkaline solution. The results are exact with chromium alone or in presence of iron. The determinations are inexact in presence of nickel, cobalt, and manganese.—Paul **Gaubert**: The modifications of form of crystals of some substances artificially coloured during their growth.—G. **Friedel**: The crystalline symmetries shown by the diffraction of the Röntgen rays.—L. **Blaringhem**: The hereditary transmission of rust in the hollyhock.—M. **Sauvageau**: Fucus of the Straits of Gibraltar.—J. **Vallot** and Raoul **Bayeux**: Experiments made at Mont Blanc, in 1913, on spontaneous muscular activity at very high altitudes. The daily work done by a squirrel at the summit of Mont Blanc was reduced to one-seventh of the daily work done at Chamonix.—M. **Piettre** and A. **Vila**: The study of the plasmas after sugar dialysis.—Louis **Roule**: The influence exerted by the reproductive function on the migrations of salmon in spring and summer. There is a definite relation between the ascent of rivers by salmon and the condition of their reproductive organs.—A. **Trillat**: The influence of surface tension of liquids on the removal of micro-organisms by an air current. If air is bubbled through a liquid containing micro-organisms in suspension, the latter may be carried on with the air current if the droplets of liquid produced are sufficiently small, and the size of the drops is governed by the surface tension of the liquid.—L. **Mengaud**: The lower Aptian marl of the province of Santander.—G. J. **Painvin**: New contribution to the geology of the region of high plateaux situated to the north and north-west of Bou-Denib.—René **Fourtau**: The echinitic fauna of the raised shores of the Red Sea.—G. **Vâlsan**: Remarks on the terraces of the eastern Roumanian plain.

New South Wales.

Linnean Society, November 26, 1913.—Mr. W. S. Dun, president, in the chair.—W. N. **Benson**: The geology and petrology of the Great Serpentine Belt of New South Wales. Part iii., Petrology. A detailed account of the rocks collected over the whole area described in parts i.–ii. The material is classified under (A) igneous rocks, twelve divisions; and (B) sedimentary rocks: (*a*) clastic rocks of the Eastern Series, the Tamworth Series, cherts and breccias; (*b*) the limestone; (*c*) Baldwin Agglomerates; (*d*) Barraba, Burindi, and Rocky Creek Series; (*e*) Permo-Carboniferous sandstone.—F. H. **Taylor**: A revision of the Culicidæ in the Macleay Museum.—Dr. R. **Greig-Smith**: Contributions to our knowledge of soil fertility. Nos. vii.–xi. (vii.) When soils are heated or treated with volatile disinfectants, the bacterial development depends upon the amount of fatty matter present. Field soils show little difference, while a garden soil produced about ten times more bacteria, when treated with chloroform, than when heated at 65°. (viii.) The demonstration of toxins in soils depends upon obtaining a soil in which the toxins preponderate over the nutrients, and in using an appropriate dilution in making the extracts. Equal parts of soil and water generally yield the most toxic extract. (ix.) Rain removes toxin from soil, but the toxicity returns with dry weather. Similarly, a soil originally toxic, becomes non-toxic when extracted with water, and the toxicity reappears upon incubation in the moist condition. (x.) When nitrogenous, organic matter is saturated with wax or vaseline, and subsequently treated with chloroform, it does not decay any quicker on account of the treatment. (xi.) Naphthalene induces an increase in the number of bacteria in soils.—Dr. J. M **Petrie**: Note on the occurrence of strychnicine. The native strychnine-tree, *Strychnos psilosperma*, contains the alkaloid strychnicine, which was discovered, in 1902, in the leaves of the Nux-vomica. Its properties differ from those of strychnine or brucine.—R. J. **Tillyard**: A study of the Odonata of Tasmania, in relation to the Bassian Isthmus. Though the dragonflies of Tasmania are fairly well known, the number of species is small, particularly on rivers; still waters support a more abundant fauna. A comparison made with the dragonfly fauna of southern Victoria gives the following results. Of the forms that breed exclusively in running water, about 22 per cent. of the Victorian fauna are found to have reached Tasmania. Of the forms that breed in still water about 80 per cent. have reached Tasmania. The 20 per cent. that failed to do so, all belong to the most recent genera, which have come into Australia from the north. The reason suggested for the discrepancy is that, throughout a long period, the connection between the island and S. Victoria was of such a nature that few permanently running water-courses were formed.

BOOKS RECEIVED.

Lowson's Text-Book of Botany. Indian edition. Adapted by M. Willis, with a preface by Dr. J. C. Willis. Pp. xii+602. (London: W. B. Clive.) 6*s.* 6*d.*

Annuaire Astronomique et Météorologique pour 1914. By C. Flammarion. Pp. 427. (Paris: E. Flammarion.) 1.50 francs.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-Verbaux des Réunions. Vol. xix. Procès-Verbaux. Juillet 1912–Juillet 1913. Pp. vii+142. (Copenhague: A. F. Host et Fils.)

La Face de la Terre (Das Antlitz der Erde). By Prof. E. Suess. Translated by E. de Margerie. Tome iii. (3e Partie.) Pp. x+957–1360. (Paris: A. Colin.) 12 francs.

Canada. Department of Mines. Mines Branch. The Production of Copper, Gold, Lead, Nickel, Silver, Zinc, and other Metals in Canada during the Calendar Year 1912. By C. T. Cartwright. Pp. 86. (Ottawa: Government Printing Bureau.)

Summary Report of the Mines Branch of the Department of Mines for the Calendar Year Ending December 31, 1912. Pp. ix+174+xvi plates. (Ottawa.) 15 cents.

Records of the Survey of India. Vol. iii., 1911–12. Prepared under the direction of Col. S. G. Burrard. Pp. ii+176+12 maps. (Calcutta: Superintendent, Government Printing, India.) 6*s.*

Smithsonian Institution: Bureau of American Ethnology. Bulletin 83. Chippewa Music, ii. By F. Densmore. Pp. xxi+341+45 plates. (Washington: Government Printing Office.)

Traité Raisonné de la Pisciculture et des Pêches. By Prof. L. Roule. Pp. viii+734. (Paris: J. B. Baillière et Fils.)

The A.B.C. Guide to Astronomy. By Mrs. H. P. Hawkins. Third edition. Pp. 124. (London: Simpkin and Co., Ltd.; Bedford: Beds. Times Publishing Co., Ltd.) 1*s.* 6*d.* net.

The Revolving Star Map with Movable Declination Scale. By Mrs. H. P. Hawkins. (London: Simpkin and Co., Ltd.; Bedford: Beds. Times Publishing Co., Ltd.) 1*s.* net.

The Star Almanac for 1914. By Mrs. H. P. Hawkins. (London: Simpkin and Co., Ltd.; Bedford: Beds. Times Publishing Co., Ltd.) 6*d.* net.

Experience Teaches. By I. Trinda. Pp. xiv+194. (London: Simpkin and Co., Ltd.) Limp leather, 4*s.* net; cloth, 2*s.* 6*d.* net.

Department of Commerce and Labor Bureau of the Census. Thirteenth Census of the United States taken in the Year 1910. Statistics. 52 parts. (Washington: Government Printing Office.)

New Zealand. Dominion Museum. Bulletin No. 4. The Stone Implements of the Maori. By E. Best. Pp. 410+li plates. (Wellington: J. Mackay.)

Ministry of Finance, Egypt. Survey Department. The Value of Gravity at Eight Stations in Egypt and the Sudan. By P. A. Curry. Pp. 65+v plates. (Cairo: Government Press.) P.T.10.

Essays and Studies Presented to William Ridgeway on his Sixtieth Birthday, August 6, 1913. Edited by Dr. E. C. Quiggin. Pp. xxv+656+plates. (Cambridge University Press.) 25s. net.

Celluloid Dangers with Some Suggestions. By D. W. Wood. Pp. 36+plates. (London: British Fire Prevention Committee.) 2s. 6d.

Catalogue of Lantern Slides. Part ii. Pp. xx+351–918. (London: Newton and Co.)

Catalogue of the Noctuidæ in the collection of the British Museum. By Sir G. F. Hampson, Bart. Pp. xiv+609; plates ccxxii–ccxxxix. (London: British Museum (Natural History); Longmans and Co.)

The Animal Kingdom. By Dr. Zwanziger. Translated by G. K. Gude. Pp. vi+92. (London: S.P.C.K.) 8s. 6d. net.

Meteorological Office. The Observer's Handbook. Annual Edition, 1913. Pp. xxiv+157+plates. (London: H.M.S.O.; Wyman and Sons, Ltd.) 3s.

Die Riviera. By A. Voigt. Pp. vi+466+vi plates. (Berlin: W. Junk.) 7 marks.

Sound. By Dr. J. W. Capstick. Pp. vi+296. (Cambridge University Press.) 4s. 6d.

Cambridge County Geographies:—Northumberland. By S. R. Haselhurst. Pp. xi+181+2 maps. Merionethshire. By A. Morris. Pp. ix+166+2 maps. (Cambridge University Press.) Each 1s. 6d.

Handbuch der Arbeitsmethoden in der anorganischen Chemie. Edited by Dr. A. Stähler. Dritter Band. Allgemeiner Teil. Erste Hälfte. Pp. x+692. (Leipzig: Veit and Co.) 22 marks.

International Congress of Americanists. Proceedings of the Eighteenth Session. London, 1912. Parts 1 and 2. Pp. lxxxviii+570+plates. (London: Harrison and Sons.) 2 guineas net.

Travaux et Mémoires du Bureau International des Poids et Mesures. Tome xv. (Paris: Gauthier-Villars.)

DIARY OF SOCIETIES.

THURSDAY, JANUARY 8.

CONCRETE INSTITUTE, at 7.30.—Factory Construction: P. M. Fraser.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—British Practice in the Construction of High-tension Overhead Transmission Lines: B. Welbourn.

FRIDAY, JANUARY 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Hydrogen and the Primary Constituents of Nebulæ: J. W. Nicholson.—The Short-period Variable XZ Cygni: C. Martin and H. C. Plummer.—A New Algol Type Variable Star in Pegasus: A. Stanley Williams.—*Probable Papers:* The Number of Stars of Each Photographic Magnitude down to 17·0 m. in Different Galactic Latitudes: S. Chapman and P. J. Melotte.—The Proper Motions of the Brighter Stars within 17° of the Pole, considered in relation to their Spectral Type: H. S. Jones.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Application of Power Railway Signalling in Great Britain: C. I. Routh.

MONDAY, JANUARY 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Evolution of the Federal Capital, Australia—Canberra: G. Taylor.

TUESDAY, JANUARY 13.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Superheating Steam in Locomotives: H. Fowler.

THURSDAY, JANUARY 15.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Some Scientific Results of Captain Scott's Antarctic Expedition: G. Taylor.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Museums: A Centenary Retrospect: Col. T. H. Hendley, C.I.E.

INSTITUTION OF MINING AND METALLURGY, at 8.

LINNEAN SOCIETY, at 8.—Lantern Slides Illustrating the Fauna and Flora of the Interior of Vancouver, from her last journey: Mrs. Henshaw.—Some Observations on the Tentacles of *Blennius gattorugine*: H. A. Baylis.—(1) Some Recent Additions to the British Flora; (2) A Note on Article 45 of the Vienna Code; (3) The Abridgment of Miller's "Gardener's Dictionary" of 1754, and Hill's "British Herbal" of 1756: G. C. Druce.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Discussion on Mr. C. J. Waldram's Paper: Some Problems in Daylight Illumination, with Special Reference to School Planning."

FRIDAY, JANUARY 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Commercial Tests of Internal Combustion Engines: W. A. Tookey.

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THURSDAY, JANUARY 15, 1914.

APPLICATIONS OF POSITIVE RAYS.

Rays of Positive Electricity and their Application to Chemical Analysis. By Sir J. J. Thomson, O.M., F.R.S. Pp. vii+132+5 plates. (Longmans Green and Co., 1913.) Price 5s. net.

ALL physicists and chemists will welcome this account by the author of his wonderful series of researches, begun seven years ago, on positive rays. This name, "positive rays," is preferable to "canal-rays," originally applied to the stream of positively-charged particles which passes through a hole in a flat cathode; and the author's choice of the word "particle" to denote an atom carrying a positive charge, and the word "corpuscle" for what is generally now termed an electron, will not be challenged.

After a description of Goldstein's experiments, an account is given of Wien's discovery that these rays are deflectable by powerful magnetic fields. The theory of the deflection is shortly and clearly stated; and also the theory of the electrostatic deflection of a particle. Then follows an account of the author's first experiments, made in 1906, for which he devised an apparatus allowing of the simultaneous application to a bundle of positive particles both an electrostatic and a magnetic force. The arrangement is so devised as to apply these forces at right-angles to each other; and the result, as Sir Joseph Thomson has described in numerous papers and lectures, is to convert the luminous point (if a Willemite screen be used) into a parabola. The position of the parabola on the screen is conditioned by the intensity of the forces applied; but if these be kept uniform, it depends, *inter alia*, on the masses of the particles. Now the mass is simply related to the atomic or molecular weight, and hence the nature of the particles can be identified.

It is found, however, that the same mass may hold one or more charges; hence in deducing the atomic weights, this has to be borne in mind.

Descriptions are given, with figures, of the instruments employed; but from a practical point of view the figures might have been improved. In Fig. 6, for example, connections for maintaining an electrostatic field are not shown, and neither in that figure nor in Fig. 13 is any arrangement shown for introducing gas. Indeed, one wonders, in reading this book, what gases were present to cause the kathode rays to pass, for they cease in a high vacuum. Sir Joseph Thomson points out the necessity for removing air very thoroughly with a pump before applying absorption with cooled charcoal; are the residual gases traces of neon and helium? or are they minute traces of oxygen and nitrogen, corresponding to the vapour-pressures of the gases condensed on the charcoal? or do the conducting gases come off the electrodes, or off the walls of the tube? It would have been useful if information on this point had been given. In this connection, on p. 25, we are told that the gas to be used is kept in *A*, Fig. 13; but there is no means of introducing a gas into *A*; the gas is said to be stored over a column of mercury; how then is mercury vapour excluded? The same want of precision applies to the description of the photographs. It is exceedingly difficult, if not impossible, to follow on the plates the peculiarities described in the text; for example, Fig. 28 is described on pp. 48 and 49. Eight parabolas are mentioned in the text, but only five appear in the photograph. Possibly the negatives may show more than the prints; but if so, it should have been stated, and a diagrammatic reproduction of the photographs should have been given. In this connection, too, it may be mentioned that there is a considerable number of misprints; the well-known "effect" is due to Doppler, not Döppler; and commas are frequently substituted for semi-colons.

The ingenuity with which various effects are analysed and alternative hypotheses tested is extraordinary; Sir Joseph Thomson possesses scientific imagination in the highest degree, combined with the power of mathematical presentation and wonderful experimental skill. Take the following passage:—

"We can form an estimate of the magnitude of the attraction between a neutral atom and a corpuscle. From the measurement of the plates we find that there are negatively electrified atoms of hydrogen with a velocity as large as 2×10^8 cm. sec. This means that a neutral atom of hydrogen is able to capture a corpuscle even though it is moving past it with this velocity. This capture, however, would not take place unless the work required to remove a corpuscle from the surface of a neutral atom of hydrogen were greater than the kinetic energy of a corpuscle moving with the velocity of 2×10^8 cm./sec. This kinetic energy is equivalent to the fall of the atomic charge through 11 volts; hence we see that it must require an ionising potential of more than 11 volts to liberate the corpuscle from a negatively electrified atom of hydrogen. The same considerations show that to liberate the corpuscle from a negatively electrified atom of carbon would require at least 0·9 volt, while for oxygen the corresponding ratio would be 0·7 volt. It must be remembered that these are merely inferior limits; the actual values may be much larger."

It is interesting to note that evidence has been obtained of the transitory existence of such groupings as CH_3, CH_2, and CH, as well as of groupings of two and of three carbon atoms; the last are produced only when the vapours of complex carbon compounds are induced to form "positive rays."

The question of multiple charges carried by an atom is discussed at considerable length; it would appear that a mercury atom may carry as many as 8 charges; an atom of krypton, 4 or 5; one of argon, 3; one of neon, 2; of nitrogen and of oxygen, 2; and of helium, also 2; no hydrogen atom with more than one charge has been observed. The larger the number of charges carried, the fainter the line. But the intensity of the parabolic line, whether seen on a Willemite screen or photographed, is by no means proportional to the amount of element producing it. The hydrogen parabola, for instance, is always much more intense than would be accounted for by the relative amount of hydrogen present. To prove this, a most ingenious device was adopted; a parabolic slit in the screen was interposed between the source of the rays and a metallic box, connected with an electrometer; by altering the intensity of the magnetic field, the parabolas were made to fall on the slit, and the rays passed through into the box, and registered their intensity on the electrometer. In this way the relative quantity of the gaseous elements present was estimated with fair accuracy.

Proof was also obtained that helium is a monatomic gas, while oxygen and hydrogen are diatomic; for in the discharge-tube, besides detachment of a corpuscle from a molecule, the splitting up of a molecule into its constituent atoms takes place.

Chapters follow on retrograde and on anode rays; and Stark's interesting observations on the Doppler effect are described and amplified; also a short account of the spectra produced by bombardment with positive rays.

Next follows a chapter on the use of positive rays for chemical analysis; the preface states that "one of the main reasons for writing this book was the hope that it might induce others, and especially chemists, to try this method of analysis." I fear that it will not have this result. It is a pity that Sir Joseph Thomson in this chapter had not given a more detailed account of his methods, with more elaborate diagrams of the apparatus. Even to one skilled in work of this nature, what appear no doubt commonplaces to him require elucidation. For example, how many amperes are necessary to incite his magnets? What is the size of the magnets? What electric field is required? What voltage must be applied to the plates giving an electrostatic field? One would require to visit the Cavendish laboratory, or to trouble its director with correspondence before one could set up an apparatus in working order.

A discussion then follows of Mr. Aston's interesting investigation of neon, with the object of ascertaining whether neon, which has the atomic weight 20·2, contains a gas of atomic weight 22; the existence of the latter is indicated by positive rays in neon. To my mind it is scarcely credible that a mixture of gases, separable by diffusion, as Mr. Aston finds, cannot be separated by distillation and yet neither Mr. Watson, who determined the atomic weight of neon, nor Mr. Aston, who repeated Mr. Watson's experiments, have been able to effect any separation by fractionation. Further work, however, will no doubt settle the question. The existence of "X_3" is next treated of; and the reasons for believing it to be a hydrogen "ozone" appear to be cogent.

Finally, Sir Joseph Thomson deals with the continuous production of helium when certain substances are bombarded with kathode rays. Again, he does not inform us what gas was present. He is rightly very cautious in drawing any definite conclusions from his experiments; but at present his bias is in favour of the possibility of disintegration; that the matter bombarded disintegrates into helium, and some other "elementary" form of matter. He says:—"The view that helium can be got from other chemical elements raises questions of such a fundamental character that few will be prepared to accept it until every other explanation has been found to be untenable." The production of helium from radium, from niton, from thorium, and from actinium is now accepted as an undoubted fact; questions of "a fundamental character" have been raised and answered; and it appears to me to need a very small stretch of imagination to suppose that while some "elements" spontaneously undergo exothermic changes with evolution of helium, others require external sources of energy before disruption takes place.

W. R.

GEOLOGY AND MINERALOGY.

(1) *The Earth: Its Genesis and Evolution considered in the Light of the most recent Scientific Research.* By A. T. Swaine. Pp. xix+277+xi plates. (London: C. Griffin and Co., Ltd., 1913.) Price 7*s*. 6*d*. net.

(2) *Grundzüge der geologischen Formations- und Gebirgskunde.* By Prof. A. Tornquist. Pp. iv+296. (Berlin: Gebrüder Borntraeger, 1913.) Price 6.80 marks.

(3) *Determinative Mineralogy.* With Tables for the Determination of Minerals by means of their Chemical and Physical Characters. By Prof.

J. Volney Lewis. Pp. v+151. (New York: John Wiley and Sons; London: Chapman and Hall., Ltd., 1913.) Price 6s. 6d. net.

(1) Mr. Swayne's book represents extensive reading in geological reports and journals, some of which are not easy to procure. The references to authors require some correction—T. C. Chamberlin, for instance, is consistently quoted as "Chamberlain"—but they are well chosen and are thoroughly suggestive to the student. Thanks to this free acceptance of the results obtained by field observers in many lands, a great deal of stratigraphical information is to be found within these pages. The author, however, is possessed by an idea, which forms the undercurrent of the book, and must appear somewhat startling to petrologists, if not also to biologists. He holds that the "globes of condensed vapour" (p. 9) that occur in nebulæ pass into a liquid state, producing, if we read aright, globes of water in which certain elements are dissolved.

Through the development of protoplasm in this water, and the withdrawal of the elements from solution by organisms seeking to form hard parts, a rain of mineral matter descends, and a stony nucleus is built up from the centre outwards. Calcium carbonate cannot exist in great oceanic depths, and consequently the first deposits were siliceous, and were followed by calcareous matter, similarly arising from the tests of organisms. The red clays of deep seas represent material intermediate between these types; but the chemical actions required to produce them from shells are admittedly obscure. Wherever deep oceanic basins existed during geological times, the same order of deposition has been followed (pp. 19—21); the quartzites and sandstones in such cases, which in reality mark the first sediments in a sinking area, are regarded as formed from radiolaria in a great persistent hollow which has gradually become infilled. The calcareous oozes thus represent the latest and shallowest stage.

The application of this theory to the Upper Cretaceous series of Europe (p. 22) leads to a very confused argument. Terrigenous deposits are recognised at the base, and yet these are used to support the statement that "the $CaCO_3$ decreases with the depth." Petrological examination would have kept the author from many unjustified suggestions, such as that in regard to laterite (p. 198), which is treated, in spite of an abundant literature, as an oceanic ooze. The book is obviously not a safe one for beginners, though its illustrations and mode of production go far to commend it to the reader.

(2) Prof. Tornquist's introduction to geology is of a very different order. He also reaches a description of oceanic sediments on his tenth page, and interestingly refers to Philippi's suggestion that in past times, when no polar ice-caps existed to produce unfavourable coldness, calcareous organic deposits could be formed over the deep-sea areas in general. As is fitting in a work emanating from Königsberg, the rocks of the "Eozoicum" find their type in the admirable exposures of Fennoscandia; but the absence of many formations from eastern Prussia enables the author to be wisely eclectic. Due prominence is thus given to the Silurian strata of Wales and of Bohemia; the Permian and Triassic systems receive far more adequate treatment than is usual in English text-books; and we have a good account of the Jurassic rocks of central Germany. On the other hand, we may feel that four lines (p. 222) form an insufficient reference to the Cretaceous beds of northern France and England. The earth-movements in the Harz area in Cretaceous times are illustrated on p. 227, and are shown to be forerunners of the "Saxon folding" that accompanied the formation of the Alps. On p. 263, the essentially modern nature of Europe is well expressed. The illustrations are excellent, and include the skeleton of *Allosaurus agilis* from the American Museum in New York. We should have liked some reference to the gnawed bones of the prey in this most terrible of zoological reconstructions.

(3) Prof. Lewis's manual may be regarded as convenient by those to whom the well-known work of Brush and Penfield seems unduly large. It follows similar lines and covers a wide field, and such recently discovered minerals as benitoite and purpurite are introduced. In every case references are given to the two text-books by J. D. and E. S. Dana.

G. A. J. C.

OCEANOGRAPHIC RESEARCHES.

Scientific Papers. By J. Y. Buchanan, F.R.S. Vol. i. Pp. xii+15 papers. (Cambridge: University Press, 1913.) Price 10s. 6d. net.

The numerous expeditions which have explored the depths of the sea since the voyage of H.M.S. *Challenger* during the years 1873–76 have added much to our detailed knowledge of the conditions occurring in various seas and oceans, and in certain cases have given some idea of the periodic and irregular physical changes which take place. But the great pioneer voyage remains the only one which has surveyed the whole world of waters, and it is remarkable how little the work of more recent years, with all its advantages of previous experience and more adequate resources, has modified the broad outlines of the *Challenger* results. It is of fundamental importance to the history of oceanography that the record of these early investigations should be made accessible once for all by the best authorities; those authorities, to wit, to whom the researches themselves were originally due. This has, of course, been done in great measure in the published narrative and reports of the *Challenger* Expedition; but, as in all other undertakings of the same order of magnitude, there is a sort of aftermath of result, the fruit of incidental inquiries into special methods or of special subsequent opportunities arising from the original main enterprise. These collateral results are necessary to complete the historic picture, both of the work and of the men who carried it out.

It is, therefore, a matter for much satisfaction that this has now been done, in so far as the physical and chemical work is concerned, by the chemist and physicist of the expedition himself. Mr. Buchanan entered upon his work with nearly everything to plan and invent, both as regards what was to be done and how it was to be done, and he has continued and expanded it in many directions since, along lines similar in many ways to those followed on the *Challenger*. We welcome this volume of reprints of his original papers, both for historical reasons and for the permanent value of the results obtained.

Of the fifteen papers reprinted in this book, two deal with the distribution of temperature under ice in Linlithgow Loch, describing observations showing the fallacy of the belief that the temperature of the water of a frozen lake is always that of the point of maximum density. With these exceptions, they are all concerned with oceanographical matters; either describing methods and results of experiment, as in the papers on absorption of carbonic acid by saline solutions, on the composition of sea-water ice, on determinations of specific gravity, or on apparatus for deep-sea investigation generally; or else giving the results of observations in special regions of the ocean. The lectures on "Laboratory Experiences on Board the *Challenger*," and "Deep-sea Investigation and the Apparatus Employed in it," are of special historical value, as they describe in full detail the instruments and methods employed in deep-sea work from the time of Columbus up to and including the *Challenger* expedition itself.

Mr. Buchanan's work after the *Challenger* expedition was largely carried on in the cable ships of the Silvertown Company, which afforded him special opportunities for research in connection with lines of soundings on the west coast of Africa. The results are embodied in important papers on the "Dacia" shoal, on the land slopes separating continents and oceans, and on the exploration of the Gulf of Guinea. The remarkable submarine valleys running out from the mouths of the Congo and other West African rivers are described.

OUR BOOKSHELF.

Cabinet Timbers of Australia. By R. T. Baker. Pp. 186 + lxviii plates. (Sydney: Technological Museum, 1913.)

This work directs attention to a section of Australian timbers which is especially suitable for cabinet work, furniture, and interior decoration.

More than sixty species, belonging to twenty-one different natural orders, are described and illustrated, the natural colour and graining of each wood being depicted by the aid of colour photography. There are also excellent illustrations in black and white of furniture and interior fittings made from several of the woods.

The coloured illustrations are the feature of the book. At first sight many of them give one the impression of being thin veneers, an impression only removed by fingering the surface of the picture. The very texture of the wood is so well brought out by this process that its working qualities can almost be predicted. We have placed actual specimens alongside the prints in several cases, and the majority of them match very closely. The text is not equal to the illustrations. Each plate is accompanied by a popular description of the timber and the uses to which it can be applied. but the information given is very meagre. This is followed by a condensed description of the tree in technical language which will only be understood by the trained botanist. The geographical range of each tree is given, but little is said about the supply available, which is one of the most important points for the trade.

The main object of the author, however, is to interest Australians themselves in their native timbers and bring home to them the necessity for taking steps to prevent these valuable timber trees being exterminated in the process of clearing the land for settlement. The book certainly brings out the fact that Australia possesses a rich assortment of beautiful cabinet woods exhibiting a wide variation in figure, texture, and colour, and the Empire, no less than the Commonwealth, will suffer an irreparable loss if steps are not taken to stop the present waste of this valuable heritage of natural wealth.

Marsh's Mathematics Work-book. Designed by H. W. Marsh. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 3s. net.

This book consists of about 250 blank unruled sheets of writing-paper of good quality, divided into two sections. Each section is fastened to the book-cover by two strong paper fasteners, so that the sheets may be removed as required. The cover is of substantial quality, having leather corners and back. Several daily record sheets are provided, and the student is expected to fill these up, giving particulars of date, portion of the text-book or work studied, remarks, as well as particulars of the time which he has spent at other subjects. The student is expected to certify this record by his signature. Pasted to the interior of the cover are elaborate instructions regarding methods of entering work done, for filling up the record sheet, excuses, collection and distribution of work-books, inspection, and corrected work. Some of these instructions are distinctly good, and might be taken to heart by many teachers of mathematics in this country. For example—"as soon as possible learn to draw a light, smooth, draughtsman's line." Those who have had the opportunity of examining the British average mathematical home-work will appreciate this quotation. No doubt the designer of this book has found that it meets perfectly the needs of his own institution and students, but we question whether it will meet with much favour in this country, where it is well known that every teacher prefers to develop his own methods as regards style of home-work, examination, and so on.

The Celebration of the Two Hundred and Fiftieth Anniversary of the Royal Society of London, July 15–19, 1912. Pp. 128. (London: Humphrey Milford, 1913.) Price 5*s*. net.

THE interesting events in connection with the celebration of the 250th anniversary of the Royal Society in July, 1912, were reported in these columns at the time, and the contents of this volume consequently cover ground familiar to our readers. This permanent record of the proceedings contains a full list of delegates and verbatim accounts of the addresses, speeches, telegrams, and letters addressed to the Society from learned societies and other bodies throughout the world. With the new edition of the "Record" of the Society, and the facsimile reproduction of the pages of signatures of the fellows in the Charter book, from that of the Royal founder down to those entered in the summer of 1912, it will form an appropriate and lasting memorial of a noteworthy celebration.

Who's Who in Science: International, 1914. Edited by H. H. Stephenson. Pp. xx+662. (London: J. and A. Churchill.) Price 2*s*. net.

THIS excellent work of reference contains, in addition to its 9000 biographies of men of science of all nationalities, other useful information. Especially convenient are the tabular statements, arranged alphabetically, of particulars about the universities of the world, which include the names in each case of the head of the university and the senior occupants of the various scientific chairs. A valuable list of the "World's Societies" is also included, and from it the name, address, number of members, the name of the secretary, and other facts can be seen at a glance. An exhaustive classified index adds greatly to the value of the volume.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Pressure of Radiation and Carnot's Principle.

I GATHER from a letter on this subject which appears in your last issue that Lord Rayleigh endorses the opinion that the partial pressure p of any particular frequency in full radiation may properly be deduced from the intrinsic energy-density E/v of the same frequency by Carnot's principle.

The other point to which I wished to direct attention is that, in the case of a steady stream of radiation of constant frequency, the heat quantity measured is the total heat of formation per unit volume, $E/v+p$, and not the intrinsic energy-density E/v as commonly assumed. The disagreement with experiment of Wien's well-known formula for the partition of energy in full radiation, is readily explained if we assume that it represents only the intrinsic energy. The corresponding value of the pressure is very easily deduced by reference to Carnot's principle, as Lord Rayleigh has indicated. The formula which I have proposed (*Phil Mag.*, October, 1913) is simply the sum of the pressure and energy-density thus obtained, and gives very satisfactory agreement with experiment, both for radiation and specific heat. I prefer it to Planck's formula (among other reasons) on the ground that the latter cannot be reconciled with the classical thermodynamics, and involves the conception of a *quantum*, or indivisible unit of action, which is unthinkable. The corresponding physical magnitude on my theory, which I have elsewhere called a molecule of caloric, is not necessarily indivisible, but bears a very simple relation to the intrinsic energy of an atom, which is all that is required to explain the fact that radiation may in special cases be emitted in atomic units which are multiples of a particular magnitude.

H. L. CALLENDAR.

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South Kensington.

Atomic Models and X-Ray Spectra.

IN his letter to NATURE of January 1 on "Atomic Models and X-Ray Spectra," Dr. F. A. Lindemann deals with the approximate agreement between the recent experiments of Mr. H. G. J. Moseley on "The High-frequency Spectra of the Elements" (*Phil. Mag.*, December, 1913), and the calculations given in my paper, "On the Constitution of Atoms and Molecules" (*Phil. Mag.*, July, September, November, 1913).

In Dr. Lindemann's opinion a theoretical explanation of Mr. Moseley's results can be obtained in several ways; and he therefore concludes that the agreement in question cannot be considered to support the assumptions used in my paper. By the help of a consideration of dimensions he seeks a relation between the five quantities, ν, r, Nne^2, m, and h. He shows that an infinite number of different expressions can be obtained for ν in terms of r, Nne^2, m, and h; and he indicates how several of these expressions may be brought in approximate agreement with the experimental results.

This procedure does not appear to me to be justified. Just as little as the five quantities ν, r, Nne^2, m, and h, the four quantities, r, Nne^2, m, and h, may be considered as independent of each other. By a consideration of dimensions we can obtain a relation between r, Ne^2, m, and h; and if we introduce this relation in Dr. Lindemann's expressions for ν, all the different expressions become identical.

By a consideration of dimensions only, we cannot calculate the numerical factors which determine the exact values for the frequencies of the spectrum of an element; in order to do this, we must introduce more detailed assumptions as to the constitution of the atom and the mechanism of emission of radiation. A discussion of the special assumptions used in my calculations will be found in a paper on the influence of electric and magnetic fields on spectral lines, which will appear shortly in the *Philosophical Magazine*.

N. BOHR.

The University, Copenhagen, January 5.

DR. F. A. LINDEMANN (NATURE, January 1) disagrees with the theoretical interpretation of my recent work on X-ray spectra (*Phil. Mag.*, December, 1913). He objects to my statement that the results so far obtained strongly support the views of Bohr, and considers that they yield no information about the structure of the atom beyond confirming the views of Rutherford and van den Broek. My work was undertaken for the express purpose of testing Broek's hypothesis, which Bohr has incorporated as a fundamental part of his theory of atomic structure, and the result of the test certainly confirms the hypothesis. In my opinion, however, further definite conclusions can be drawn from the results, and these conclusions strongly support other features of Bohr's theory. Moreover, I cannot accept the alternatives which Dr. Lindemann offers to my formula representing the values of the principal frequencies observed.

Dr. Lindemann's arguments are based on the principle of dimensions. This method of treatment is of historical interest, as we owe to it the introduction of Planck's quantum h into the discussion of atomic structure. So long as the only factors, common to all atoms, on which this structure was known to depend, were e, m, the charge and mass of an electron and Ne the charge of the nucleus, it was impossible to obtain a quantity of the dimensions of a frequency. In an electromagnetic system the introduction of c, the velocity of light, might get over this difficulty, but it has proved more profitable to treat the problem as electrostatic and make definite calculation possible by using h.

We will call the assumption that h is a fundamental factor in the atom the h hypothesis. It then follows from the principle of dimensions that the frequency of an atom, $\nu = f\frac{e^4 m}{h^3}$, where f is a numerical constant which depends on N, and also on the arrangement of the electrons in the atom.

The reason why Dr. Lindemann arrives by the same argument at an indefinite result is that he takes r, the distance of the electron from the nucleus, or else rN to be an independent factor in the calculation. No independent natural unit of length, which would apply to an electrostatic problem, is known, and the separate introduction of r or rN appears to me to be unwarranted. Bohr has pointed out that the fundamental frequency ν_0 of ordinary series spectra is obtained by putting $f = 2\pi^2$ in the formula given above, while my work shows that the frequency of the principal line in the X-ray spectrum of elements from Ca, N = 20 to Zn, N = 30 corresponds with

$$f = 2\pi^2 . \tfrac{3}{4}(\mathrm{N}-1)^2.$$

The simplicity of the expression f in these two cases is itself an argument in favour of the h hypothesis. It is, however, more strongly supported by the fact that the frequencies in the X-ray spectrum are proportional to $(\mathrm{N}-1)^2$. Two alternative explanations can be given for the occurrence of $(\mathrm{N}-1)$ and not N. It is just possible that two of the elements which precede calcium have the same atomic number. A mistake would then have been made each time in reckoning N, and ν would really be $\propto \mathrm{N}^2$. It is much more likely that the repulsion of the other electrons cannot be neglected compared with the attraction of the nucleus, and then N must be replaced by $(\mathrm{N}-\sigma_n)$. In either case we conclude that as we pass from atom to atom $\nu \propto (\mathrm{F}r^2)^2$, where F is the resultant electrostatic force on the vibrating electron. In other words, a quantity of dimensions $\mathrm{T}(\mathrm{ML}^3\mathrm{T}^{-2})^2$ remains constant, and since the mass is always the mass of an electron $\mathrm{M}^p\mathrm{L}^2\mathrm{T}^{-1}$ remains constant. By putting $p=1$ a quantity is obtained of the same dimensions as h. For these reasons I conclude that the experiments support the h hypothesis, which has been put forward in three distinct forms, first by Nicholson, then by Bohr, and recently by J. J. Thomson.

I have not succeeded in obtaining agreement between my results and the vibrations considered by Nicholson. Bohr's theory, on the other hand, explains why there is a general spectroscopic constant, ν_0, given by $f = 2\pi^2$, and at the same time demands that the principal X-ray frequency should be given by $f = 2\pi^2 . \frac{3}{4}(\mathrm{N}- \quad)^2$. This agrees with the experimental result if the vibrating system is a ring of four electrons, all vibrating together; since $\sigma_4 = 0{\cdot}96$. Two things, however, suggest that either Bohr's theory or my interpretation of it requires modification. In the first place, it fails to account for the second weaker line found in each spectrum. In the second place it is difficult to see how a ring of four electrons can store up enough energy to vibrate as a whole. Perhaps the examination of the spectra of other groups of elements will suggest a solution of these difficulties.

H. MOSELEY.

Oxford, January 5.

"Atmospherics" in Wireless Telegraphy.

WITH reference to Prof. Perry's letter on "atmospherics" in NATURE of January 8, a description of some experiments made by us in the summer of 1912, and continued last summer, may be of interest. A receiving station was erected near Rothbury, in Northumberland, with an antenna consisting of two horizontal wires stretched about 3 ft. from the ground. The receiving apparatus consisted of a galena-tellurium detector and telephone circuit coupled to two inductances connected to the antenna wires and having a variable condenser in circuit between them. The length of the antenna was varied during the experiments, but for most of the time was about 500 yards each way, the direction of the wires being approximately north-west and south-east. No earth connection was used.

The antenna was laid on a slight slope, the receiving hut being situated in a field, but in each direction the antenna wires passed through extensive woods, the whole district in the vicinity being thickly wooded. During the observations of 1912 the ground was nearly always very wet owing to the excessive rainfall.

According to the views put forward by Prof. Perry, it would naturally be expected that atmospherics would be either absent or greatly diminished in intensity with an antenna such as we used. So far from this being the case they were both numerous and loud, so much so that we adopted this form of antenna as being suitable for investigating the direction from which atmospherics emanate. For this purpose we used crossed horizontal wires connected to a form of radio-goniometer, the well-known directive effect of horizontal antennæ being thus utilised. The observations were not sufficiently numerous to justify definite conclusions being drawn, but so far as they went they tended to support Mr. Marconi's results as to the southerly origin of these disturbances.

The aërials of many stations are, of course, to some extent directive, and this may account for the comparative immunity of one station from atmospherics while another in its vicinity is more disturbed by them, although both might be affected equally by local thunderstorms.

Wilfred Hall.
H. Morris-Airey.

9 Priors Terrace, Tynemouth,
Northumberland, January 12.

A Recently Discovered Stone Circle, near Matlock, Derbyshire.

On the summit of "Bilberry Knoll," in the district of Matlock, latitude 53° 7′ $1\frac{1}{2}$″, and longitude 1° 32′ 15″ W., there are remains of what I believe to have been an important station in prehistoric times, dedicated to the sun-worship cult.

The highest point of the hill is crowned by a mound, obviously artificial, built up of large boulders and earth, and, although much disturbed, many of the stones occupy positions in which they were originally placed. Some of them appear to form part of the circumference of a circle with thirty-six bays, or divisions, of 144 ft. diameter. Near the centre there are two chambers, one in horse-shoe form, and the axis through these chambers is in line with the "Nine Ladies," a well-known circle, on Stanton Moor.

The range of hills (of which Bilberry Knoll forms the highest point, 928 ft. above O.D.) occupies a very strong natural position, and the summit was apparently further protected by ramparts, remains of which may be seen about 200 yards south of the circle mound.

The circle commands an extensive view in every direction, and there are in sight more than thirty positions which bear distinctive names.

To discover the significance of some of these positions I have taken observations of the sunset on those days usually regarded as sacred in the "Druidical," or sun-worship cult, more particularly of the May Eve and June Solstice festivals. But sunsets down to the horizon are rare, and I had no data by which to determine the true date of *May Eve*. I ultimately decided on May 11 as being consonant with May Eve (old style), and this year, on that date, the *full disc* of the sun rested upon a distant horizon (altitude 10′), exactly over the intersection of intervening hills, on an alignment N. 58° 00′ W.

At the June solstice the results were more decisive, the sunset being almost exactly over the "*Nine Ladies*." This well-known circle lies a little more than five miles away, N. 46° 30′ W., and the height of horizon is about 13′. And N. 46° 00′ E., with a similar altitude, stands "Blakelow Hill"; this hill would thus indicate the rising sun, and, conjointly with the "Nine Ladies," provides irrefutable evidence of purpose. For, whereas "Blakelow Hill" is a distinctive natural feature, the "Nine Ladies" occupies a *chosen* site, slightly below the highest ground, on a broad plateau. And, whilst it is in sight, and indicates the sunset from "Bilberry Knoll," it is not in sight from a circle only $1\frac{3}{4}$ miles away on Harthill Moor, nor from "Arbor Low," which is within $5\frac{1}{2}$ miles, though a difference of very few yards in position, on higher ground, would have placed it in sight of all three. It was therefore clearly established as an adjunct to "Bilberry Knoll."

Comparing these results with data which I have since obtained from Sir Norman Lockyer's valuable work on "Stonehenge," I find the alignment for sunset on May 6 to be about N. 61° 00′ W., but the date actually observed appears to be subject to local variation, the Roman calendar being May 9 (the date of a fair day at Matlock). Making allowance for this, and for variation in obliquity of the ecliptic, it seems probable that this hill intersection would indicate the sunset on the eve of the May year festival.

The alignment for the June solstice I make N. 47° 15′ W., which is so near as practically to confirm my conclusions.

Investigations on the various sites would, I believe, prove that the better-known Derbyshire circles, "Arbor Low," the "Bull Ring" at Dove Holes, and "Wet Withins" on Eyam Moor, were also established with alignments to distinctive features that would indicate the rising and setting sun on these dates.

John Simpson.

Spring Mount, Bank Road, Matlock,
January 5.

Trepanning among Ancient Peoples.

A note in Nature of October 30, 1913, p. 273, referring to the late Dr. Lucas Championnière's paper on prehistoric trepanning, which was read at the last annual public meeting of the Five Academies in Paris, contains this observation:—

"It is remarkable that the operation was not practised among highly civilised races like Greeks, Egyptians, Arabs, Hindus, and Chinese. . . ."

But the subjoined quotations would seem to militate with the soundness of this expression so far as it concerns the ancient peoples of Greece and India:—

"In surgery his (Hippocrates's) writings are important and interesting, but they do not bear the same character of caution as the treatises on medicine; for instance, in the essay 'On the Injuries of the Head,' he advocates the operation of 'trephining' more strongly and in wider classes of cases than would be warranted by the experience of later times" ("Encyclopædia Britannica," 1910, vol. xiii., p. 518).

"The next most elaborate chapter (of the Hippocratic collection) is that on wounds and injuries of the head. . . . Trephining was the measure most commonly resorted to, even where there was no compression" (*ibid.*, vol. xxvi., p. 125).

"Jīvaka (afterwards termed the King of the Physicians) had learnt the whole art of healing with the exception of the operation of skull-opening. Now a man who was afflicted by a cerebral malady came to Atreya (Jīvaka's master) and asked him to treat him. Atreya replied that the man must dig a pit that day and provide it with dung. . . . When Atreya came, he placed the man in the pit, opened his skull, and was about to seize the reptile with his pincers (when Jīvaka advised him how to take it away). . . . When all this had been done the man was cured" (E. A. von Schiefner, "Tibetan Tales," trans. Ralston, 1906, p. 98). The same book, p. 100, relates how Jīvaka cured a man whose head itched greatly by drawing out of his skull a centipede through the same operation. In the "Lives of Jīvaka and Amrapālī (his mother)," translated into Chinese in the second century A.D., he is said to have used a golden knife in skull-opening.

"Les Saniassis sont enterrés jusqu'au col; un Religieux du même ordre casse des cocos sur la tête du mort jusqu'à ce qu'elle soit brisée; ensuite on la couvre de terre. On ignore aujourd'hui le motif de cette pratique singulière, à moins que ce ne soit pas pour faciliter à leur âme le moyen de sortir par une ouverture plus honnête que la bouche, les oreilles et d'autres issues du corps, qu'on regarde comme impures et souillées" (Pierre Gonnerat, "Voyage aux Indes Orientales et à la Chine," à Paris, 1782, vol. i., p. 93).

KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, December 13, 1913.

Systems of Rays on the Moon's Surface.

A GREAT deal has been said, and a great many theories have been put forward, as to the cause of these marvellous systems of rays on the surface of the moon. I now venture to put forward an explanation which has occurred to me, and should like the opinion of some of your readers upon it.

It is generally admitted that the volcanic action of the moon was of an enormous character, "even when the low force of lunar gravity is taken into consideration," and from our knowledge of the amount of lava emitted from one of our own small craters, we can conceive what a huge volume must have been thrown out from such gigantic craters as Clavius, Ptolemäus, or Copernicus. Now, from what we can see even to-day, the lunar surface is exceedingly mountainous, and I suggest that when these craters were in their full power huge volumes of lava were thrown out, and in many cases practically filled up valleys, or cañons between the mountains. We know the rays are from five to ten miles broad, even up to twenty miles, and from the action of the volcano there would always be the tendency for the lava to run away from the crater itself, thus forming these rays, like spokes from a hub. Some of the rays are, however, apparently of a prodigious length, up to 2000 miles long, but Prof. Pickering tells us that this length is an illusion, the long rays being made up of rays from different craters, which appear to form one long continuous ray, which satisfies the question of length.

Then many of these rays apparently run right across and almost obliterate (at full moon) such craters as Clavius and Maginnus. Now I think it is generally admitted that the ray systems from Tycho, Copernicus, and Kepler are the largest on the moon, and they are also three of the very largest craters. This points to the fact that they were the first eruptions on the lunar surface, and being the first, threw out the greatest volume of lava. This filled up the valleys in their neighbourhood, but afterwards other craters were erupted through the lava-covered rocks, though without breaking up the "lava valleys." It is highly probable that in these circumstances most, or all, the craters have their rays, though too small to be detected through even the largest glass. Their brilliance would, of course, be accounted for, by the sun shining directly upon them, through no atmosphere at all, or none worth mentioning. It seems, therefore, to me, that these rays must be geologically old remains of eruptions, dried up now, but still showing themselves on the lunar surface, though it is doubtful if the matter will ever be satisfactorily cleared up.

C. HUBERT PLANT.

49 Lichfield Road, Walsall, December 16, 1913.

THE CAPE OBSERVATORY.[1]

IN the preface to this work Sir David Gill relates that when, as a young astronomer, he was connected with Lord Crawford in the design and erection of the observatory at Dun Echt, he turned for assistance to Wilhelm Struve's "Description de l'Observatoire Astronomique Central de Poulkova." Remembering the help and pleasure which Struve's work had given him, he resolved, in humble imitation, to write a description of the Cape Observatory.

"Struve," in the words of Gill, "had the true genius and spirit of the practical astronomer, the love of refined and precise methods of observation, and the inventive mechanical and engineering capacity."

Struve had the rare opportunity of building an observatory after his own heart, regardless of expense, which should fulfil the highest requirements of the astronomy of his time. Gill, animated by the same spirit as Struve, and with similar qualifications, greatly extended and remodelled an historic observatory. Thanks to his grasp of the trend of astronomy, his skill in the design and construction of instruments, and his administrative ability and energy, he left the Cape Observatory, at the close of his directorate, one of the best equipped and most efficient observatories in the world.

The volume, as its title indicates, is divided into two parts. The first consists of a history of the observatory from its foundation to the present time, with brief biographical notices of those who have filled the position of H.M. Astronomer, and an appreciative criticism of their work and their contribution to the development of the observatory. Following this is a brief account of the past and present instrumental equipment, and a comprehensive survey of the important astronomical and geodetic results which have proceeded from the Cape Observatory. The second part of the book is devoted to a detailed description, illustrated by many photographs and diagrams, of the important instruments which have been erected at the observatory during Sir David Gill's directorate.

The value of the Cape as a site for the extension of astronomy and geodesy to the southern hemisphere was first appreciated by Lacaille, who in a brief visit in the middle of the eighteenth century made observations of the positions of more than 10,000 stars, and measured an arc of the meridian.

After the British occupation, the establishment of a permanent observatory at the Cape was considered by the Board of Longitude in February, 1820; the appointment of an astronomer was recommended, and estimates were obtained from Troughton, Dollond, and Jones for suitable equipment. The Board of Admiralty expressed its concurrence with this proposal, and the observatory was established by Order in Council on October 20, 1820, the staff to consist of one astronomer, one assistant, and one labourer.

The Rev. Fearon Fallows, fellow of St. John's College, Cambridge, was appointed H.M. Astronomer, and directed to make observations so far as possible similar to and complementary to those at Greenwich. He fixed the site of the observatory on part of a bare, rocky hill, covered with thistles and infested with snakes, but tolerably free from the sandy dust prevalent near Cape Town, and commanding a good view of Table

[1] "A History and Description of the Royal Observatory, Cape of Good Hope." By Sir David Gill, K.C.B., F.R.S. Pp. cxc+136+plates. (London: H.M. Stationery Office, 1913.)

Bay, so that ships anchored there might be able to observe the time-signals. The order to commence building was signed in 1822, but did not reach Fallows until 1825. After a change of Government in 1827, 10,000*l.* was cut off the estimates for building, so that when completed the observatory was a mere block of masonry on a desolate hill, without protection, an adequate water supply, or roads. The instruments were, however, installed, and some valuable observations made.

Fallows died in 1831, after eleven years' work, full of anxiety and disappointment, and was succeeded by Henderson, who remained at the Cape only one year, but crowded into that time an enormous number of observations of various kinds. His most permanently valuable work is his catalogue of positions of the principal southern stars, obtained with similar accuracy to that of the northern stars at the same epoch, but his most striking discovery and that which his name invariably calls to mind, is his determination of the parallax of α Centauri.

Henderson's successor was Maclear. He remained director of the observatory from 1833–70. Maclear was a man of great energy and practical ability. He faced the difficulties which had disheartened Fallows, and from which Henderson had shrunk, and succeeded in making the barren hillsides into fertile grounds, in obtaining a pure water supply, in breaking the force of the south-east winds by planting trees, and establishing a communication with the main road to Cape Town. At the same time the scientific work of the observatory was carried on untiringly, both with the meridian instruments and equatorials. Owing to the smallness of the staff, the observations were not all reduced and published at the time, but Maclear's successors, Stone and Gill, were able to publish these valuable observations. In addition, he found opportunities to extend help and infuse enthusiasm into the educational and scientific projects of the growing colony.

Maclear was succeeded by Stone. He had been trained at Greenwich in the systematic school of Airy, and left as a lasting monument of his nine years at the Cape (1870–79) a catalogue of 12,881 stars.

Gill was appointed H.M. Astronomer on February 19, 1879, and retired on February 19, 1907, after completing twenty-eight years of service. At the University of Aberdeen he had the good fortune to come under the influence of Clerk Maxwell, and gain inspiration from his teaching. His interest in astronomy began with the installation of a time service for Aberdeen, which he carried out with the assistance of David Thomson, professor of natural philosophy. Shortly afterwards he purchased a 12-in. mirror, mounted it equatorially, and used it in measuring double stars, taking photographs of the moon and other observations. In 1872 he was offered charge of the observatory which Lord Lindsay was erecting at Dun Echt; he relinquished his business career, and accepted without hesitation the opportunity thus presented of devoting his whole time to science.

Gill now entered on the congenial task of assisting in the design and erection of Lord Lindsay's magnificent private observatory, and the testing, mounting, and adjustments of its numerous instruments. Soon afterwards he accompanied Lord Lindsay to Mauritius to observe the transit of Venus, and in this connection made several important determinations of longitude. In 1877 he made an expedition to Ascension, and from observations of Mars with a 4-in. heliometer, determined the solar parallax as $8{\cdot}78''$, with a probable error of $\pm 0{\cdot}012''$.

Thus fitted by his training and experience, Gill found at the Cape Observatory ample scope for his energy and for his mechanical and observational skill. In 1879 the only instruments at the Cape were the non-reversible transit-circle, the 7-in. equatorial, and the photoheliograph. During his tenure of office a 7-in. heliometer, an astrographic equatorial of 13 in., the Victoria telescope, presented by Mr. McClean, consisting of a 26-in. photographic telescope for spectroscopic work, with an 18-in. guiding telescope, and a new reversible meridian circle were all added to the equipment, and from all these instruments important results have already been obtained. With the non-reversible transit instrument observations of fundamental stars, bright southern stars, and stars the positions of which were required as comparison stars for heliometer observations were carried on systematically, and particular mention may be made of a catalogue of 8650 reference stars for the astrographic work at the Cape.

From the commencement of his tenure of office Gill urged the necessity of a reversible instrument for fundamental work. The project was not sanctioned, however, until 1897. The greatest care was lavished on the instrument, the building and the foundations. The full description, occupying one hundred pages of the book, and illustrated by many photographs and drawings, cannot be summarised in a short review, and only a bare mention can be made of the most striking and interesting features. Besides being reversible, the object-glass and eye end of the instrument are interchangeable, so that flexure may be eliminated, except for the sagging of the wire, in the mean of opposite positions. The microscopes are carried on iron piers, which are covered externally by non-conducting material, and are filled with water so that their temperature may be uniform in horizontal layers, and no tendency to twist be introduced. To detect any shift of the telescope in azimuth, stable meridian marks are obtained by connecting optically the marks and collimator lenses N. and S. of the instrument, with points fixed on the solid rock at the bottom of deep iron cylinders. These have proved so successful that the movement of the pole in azimuth corresponding to the variation in latitude has been observed. The instrument is furnished with an impersonal micrometer for the elimination of magnitude equation from the observations of right ascension. To save the strain on the observer this is moved at approximately the right rate by an electric motor with suitable mechanism for giving the rate corresponding to the declination of the star. The great success of this instrument is attested by the results already published by Mr. Hough.

A full description is also given of the Victoria telescope, presented to the observatory by Mr. Frank McClean. It is furnished with a spectroscope for the determination of velocity in the line of sight, and with two large objective prisms of 24 in. aperture and refracting angles of 8° and 12° respectively. These can be used singly or together. Excellent results, including a determination of the solar parallax by Dr. Halm, have been already obtained with the line of sight spectroscope. The Cape Observatory is therefore, thanks to the generosity of Mr. McClean, admirably equipped for astrophysical work.

While the reversible transit-circle and the Victoria telescope are probably the instruments which will be most valuable to Sir David Gill's successors, it is with the 7-in. heliometer that most of his own personal observing work has been done. This instrument was obtained in 1887 to supersede the 4-in. used at Ascension. With it (partly in cooperation with Dr. Elkin) he made the well-known determinations of the parallax of the sun and of the brightest stars of the southern hemisphere, remarkable alike for the smallness of their accidental error and the care with which causes of systematic error were eliminated. In addition, the 7-in. heliometer has been used in other important investigations, particularly in the determination of the mass of Jupiter and the orbits of its satellites, researches in which two young astronomers, Mr. Bryan Cookson and Mr. de Sitter cooperated.

Sir David Gill includes an account of the Cape Photographic Durchmusterung. Knowing that this survey of the southern sky was proposed, Prof. Kapteyn volunteered to undertake the arduous work of measuring the photographs and discussing the results. From this cooperation, a catalogue containing the magnitudes and approximate positions of 450,000 stars resulted, giving a complete survey of the southern skies; it is noted that the preparation of this work first directed Kapteyn to the study of the problems of cosmical astronomy.

A very interesting account of the Geodetic Survey of South Africa is supplemented by an appendix by Dr. Wilhelm Bahn (translated from the *Beiträge zu Geophysik*) on the South African arc of meridian. Arcs of meridian were measured by Lacaille and Maclear, and between 1859 and 1862 the triangulation of the southern coast of Cape Colony was taken in hand. Soon after Gill's appointment, he pointed out to Sir Bartle Frere the advantage to be gained by a comprehensive survey, and recommended a gridiron system of chains of principal triangulation extending over the Cape Colony, the Orange Free State, Natal, and the Transvaal. This work has been carried out under the direction of Sir William Morris in the field, with Sir David Gill as scientific adviser, who kept constantly in view the service to geodesy which would be derived from the measurement of a large arc on the 30th meridian of east longitude. This was afterwards continued through Rhodesia, and the extreme arc measured extends over nearly 22° from 31° 36′ S. lat. to 9° 41′ S. lat. There are six base-line determinations along the arc, and sixty determinations of astronomical latitude. The measures of the South African arc of meridian indicate a somewhat larger terrestrial spheroid than that of Clarke, and are in accordance with the results obtained by Hayford in the United States. The extension of this arc to join the Egyptian arc, and the connection round the eastern end of the Mediterranean to join the Russian arc measured by Struve is of great scientific importance, and, as Sir David Gill points out, offers no very formidable difficulty if international cooperation is secured.

In this article only portions of the volume have been touched upon. Sir David Gill is to be congratulated on the production of a work the historical and narrative portions of which are of interest to all men of science, while the technical portions are of the greatest value to astronomers. He may be assured that others will find guidance and inspiration in this history of the Cape Observatory, as he himself did in Struve's account of Pulkova.

F. W. DYSON.

SCIENTIFIC METHODS OF IDENTIFYING PICTURES.

UP to the present time the identification of works of art has been entrusted entirely to the art expert, who brings to bear upon the problem his wide experience and artistic training; and, in addition, it is probable that among those engaged in buying and selling pictures, many devices kept as trade secrets are useful in identifying pictures. While not for a moment denying that the final word should lie with the trained art expert, it is of interest to see how far scientific methods can be brought to bear upon this problem. The first step in this direction is a careful study of the history of pigments. By the examination of ancient documents, such as the illuminated manuscripts of the monks, Venetian Ducali, and the Coram Rege Rolls, it has been possible to plan out the history of pigments probably with sufficient accuracy for practical purposes, and to fix the dates approximately of certain pigments which appear and others that disappear from the artist's palette. This method, where applicable, may be regarded as infallible, as the presence of a pigment of a date more modern than the date at which the picture is supposed to be painted proves either forgery or repainting, and a careful microscopic examination make it quite possible to tell whether the picture has been repainted or not.

This, however, does not settle the authorship of the picture, and there are certain periods in the history of art during which for a considerable length of time there was no change in the artist's palette. It is necessary, therefore, to bring other methods as well to bear upon the problem. One of these is the study of mediums used at different dates, and in this study sufficient progress has been made to prove it of use for dating purposes. But, as will be obvious to a chemist, the analytical difficulties here are much more serious.

The microscopic study of pictures by magnifying under low powers revealed remarkably distinctive characters in the artists' brushwork; and the more pictures examined, the more valuable did the method appear as a trustworthy means of determining the authorship of a picture. There are probably certain schools of art to which the method does not apply. A great deal of the sixteenth-century Italian work, for instance, is handled in a very similar way, and it may be very difficult to apply this method successfully to some of these painters. But there is a wide field in which the artist has left his individual mark upon his paint, and has so drawn for the future a signature which it is impossible to forge. One of the most interesting revelations is that many of these touches are so fine as to be really beyond the limit of unaided sight. For instance, the brushwork of Teniers and of Watteau can be magnified up to four or five diameters, revealing an accuracy of touch and a delicacy of modelling and a drawing of lines which are themselves in some cases not more than one-tenth of a millimetre in diameter, and yet are put in with perfect certainty. The study of foliage is also of special interest, as each man's method of handling foliage is characteristic.

FIG. 1.—Brushwork of the head of a cow in an undoubted picture by Paul Potter in the National Gallery.

FIG. 2.—Brushwork of the head of the horse in "The Old Grey Hunter," shown by the touch not to be by Verbeecq, and inferior to Paul Potter's best work.

Among the large number of photographs taken it is difficult to know which to select as examples of the method, but probably those will be of most interest which illustrate an actual problem. Such a problem is offered by the picture in the National Gallery known as "The Old Gray Hunter," which is signed "Paul Potter," and has been stated by no less authority than Dr. Bredius to have been painted by Verbeecq, a contemporary artist. There is another Paul Potter in the National Gallery (No. 849), the authenticity of which has never been questioned, and which a comparison of photomicrographs with photomicrographs of a pedigree Paul Potter in The Hague Museum shows to be genuine.

The first photograph here reproduced (Fig. 1) is the head of a cow in this genuine Paul Potter for the comparison with the head of the horse (Fig. 2) in "The Old Gray Hunter." It is at once obvious that, while there are certain similarities in the brushwork, the painting of the horse's head is by a very inferior hand to that of the painting of the cow. The probability is, then, that it is not Paul Potter's work, although this cannot be considered as absolutely proved.

The method of photomicrography has been applied to the examination of pictures by other artists. One example examined was in a private

FIG. 3.—Brushwork of the head of an old man, from a picture in the National Gallery known to be by Teniers.

collection, and it had every appearance of being by Teniers. Curiously enough, there appeared in it an old man who is to be seen in more than one

FIG. 4.—Head from a picture described in a private collection as by Teniers but shown by the brushwork not to possess Teniers's touch.

of Teniers's genuine works. The picture, therefore, had come from Teniers's studio, as the same model was to be found in it, or it was a copy and a forgery. The two photographs reproduced in Figs. 3 and 4 show the old man as painted by Teniers in the well-known picture in the National Gallery of Teniers's "Chateau," and the face painted in the private picture. The difference of brushwork in the modelling of the face is at once apparent, while the careless painting of the beard, when compared with Teniers's, is clearly revealed.

A. P. LAURIE.

AMERICAN AND GERMAN INVESTIGATIONS ON SOIL FERTILITY.[1]

THERE is always a refreshing novelty about the publications of the American Bureau of Soils that makes an irresistible appeal to the student of agricultural science on this side of the water. We may not always agree with the conclusions reached, and we may sometimes think that the facts might be interpreted otherwise, but we cannot deny the ingenuity and freshness of the work done.

Of all difficult problems connected with the soil, few are more promising than the investigation of the remarkable carbon compounds produced during the decay of plant residues in the soil. It is known in a general way that cellulose and protein (two important plant constituents) are broken down in the soil to ammonia and carbon dioxide, but the intermediate products have scarcely been investigated in spite of the great biochemical interest of the process. Dr. Schreiner and his colleagues have recently attempted the problem, and their results are set out in a series of bulletins issued from the bureau.

Examination of the soil has shown that numerous nitrogen compounds can be obtained from it as the result of applying certain methods of extraction; among them are hypoxanthine, xanthine, guanine, adenine, cytosine, as well as the split-products of the proteins. There can be little doubt that these arise from the decomposition of decaying plant residues and other substances added as manure. The fact of their existence in the soil is of considerable interest, but it is still more interesting to inquire whether they serve any useful purpose in relation to plant growth. The current view is that they decompose to form nitrates, which are then absorbed by the plant, and built up once more into complex proteins, nucleoproteins, &c. Messrs. Schreiner and Skinner suggest that some of them at any rate are absorbed as such, and utilised direct for the formation of protein. One is accustomed to this view in animal physiology, but hitherto it has not been commonly held among plant physiologists. Experiments are here described, showing that histidine, creatinine, and asparagine caused increases in green weight in wheat, even when a

[1] "Nitrogenous Soil Constituents and their bearing on Soil Fertility." By Oswald Schreiner and J. J. Skinner. U.S. Department of Agriculture, Bureau of Soils, Bull. No. 87.
"Occurrence and Nature of Carbonised Material in Soils." By O. Schreiner and B. E. Brown. *Ibid.* Bull. No. 90.
"Studies in Soil Catalysis." By M. X. Sullivan and F. R. Reid. *Ibid.* Bull. No. 86.
"Pflanzenwachstum und Kalkmangel im Boden." By A. Wieler. (Borntrӓger, Berlin). Price 14 marks.

culture solution was present, and that a mixture of the three constituents gave better results than either separately. Maximum results were obtained when 150 parts of the substance per million were present. Evidence is presented to show that the organic compounds are absorbed as such by the plant, and are not decomposed to form ammonia, nitrites or nitrates in the solution.

The development of this new view will be watched with interest, not only by plant physiologists, but by soil students as well.

In another bulletin Messrs. Schreiner and Brown investigate the black soil material insoluble in alkalis, and find lignite particles, coal particles, and other materials, some of which suggests intermediate stages of formation. The coal-like material seemed to be present in every soil, and is considered to be formed during the decomposition of the organic matter. If this turns out to be the case it will add one more to the remarkable reactions going on in the soil.

Messrs. Sullivan and Reid have investigated the power of soils to decompose hydrogen peroxide, and they suggest that this catalytic power is due not to an enzyme, but to the inorganic and organic matter in the soil. The subject is of some interest because it is important to study the conditions under which the reactions go on in the soil.

An entirely different problem is attacked by Prof. A. Wieler in his monograph on the effect on plant growth of removing calcium carbonate from the soil, especially when this removal is brought about by smoke. This is a continuation of the author's earlier work on the effect of sulphur dioxide on plants, which led him to conclude that the injurious result was due not only to an action on the leaf, but to one on the soil. The Claustal (the region investigated by the author) has, like parts of our own Lancashire, lost its trees, and the author concludes that this has come about because the soil has become too depleted of lime for tree growth to be possible. This thesis is developed at considerable length, and a section is added on the injurious effect of metallic salts on plant growth.

NOTES.

The council of the Royal Geographical Society has made a grant of 1000*l.* towards the expenses of Sir Ernest Shackleton's Transantarctic expedition. Mr. Rudyard Kipling is to lecture before the society on February 17 upon "Some Aspects of Travel."

The Geological Society of London will this year award its medals and funds as follows:—Wollaston medal, Dr. J. E. Marr, F.R.S.; Murchison medal, W. A. E. Ussher; Lyell medal, C. S. Middlemiss; Wollaston fund, R. B. Newton; Murchison fund, F. N. Haward; Lyell fund, Rev. W. Howchin and J. Postlethwaite.

An Institution of Petroleum Technologists has been formed, with Sir Boverton Redwood, Bart., as president. Dr. D. T. Day, of the United States Geological Survey, and Prof. C. Engler have been elected honorary members of the institution. Form of application for mebership may be obtained from the secretaries, 17 Gracechurch Street, E.C.

The council of the Royal Anthropological Institute has made arrangements for an address by Prof. Baldwin Spencer, C.M.G., F.R.S., on the life of the Australian tribesmen, to be given in the theatre of the Civil Service Commission, Burlington Gardens, W., on Tuesday, January 27, at 8 p.m. The address will be illustrated by means of kinematograph films and phonograph records.

On Tuesday next, January 20, Prof. W. Bateson will deliver the first of a course of six lectures at the Royal Institution on animals and plants under domestication, and on Thursday, January 22, Mr. W. McDougall will begin a course of two lectures on the mind of savage men. The Friday evening discourse on January 23 will be delivered by Sir James Dewar on the coming-of-age of the vacuum flask.

The volcanic Mount Sakurashima, which forms an island situated at the head of Kagoshima Bay, south of Kiushiu, after being dormant for a century and a quarter, burst into eruption on Monday, destroying the villages on the island and affecting the ancient city of Kagoshima on the mainland a few miles away. It is reported that from Sunday morning to Monday more than two hundred shocks were felt in Kagoshima. When the eruption began, enormous columns of illuminated dust and vapour burst out from the sides of the volcano, and soon enveloped the whole island of Sakurashima. Forty minutes later an eruption began from the summit. The heat from the volcano was intense, and could be felt in Kagoshima. The city of Nagasaki, a hundred miles from Sakurashima, has been covered with a fine deposit of volcanic ash.

The death is reported, in his eighty-fourth year, of Mr. John Phin, the author of many popular scientific text-books, and a former editor of several New York papers, including *The Manufacturer and Builder, The Technologist*, and *The American Journal of Microscopy*. He was born in Melrose, Scotland, and was educated at the parish school, and the Musselburgh Academy, subsequently studying civil engineering in Edinburgh. He went to the United States in 1851, and afterward became professor of chemistry and technology in the People's College, Havana, N.Y., and professor of agriculture in the Pennsylvania Agricultural College. In addition to his scientific interests, he was a devoted Shakespeare student, and compiled a Shakespeare cyclopædia and glossary.

Mr. Griffith Taylor, in a paper read before the Royal Geographical Society on Monday last, described at length the topographical and geological features of the Australian federal territory, which forms an enclave in New South Wales. It is an area of considerable physiographical interest, and though only of some 900 square miles' area, participates (with the surrounding country) in four well-marked divisions, namely the Lake George plains, an undissected country of recent surface-form, the Murrumbidgee scarp and

Cullarin scarp, with "youthful" features, the Gourock highlands, &c., with their mature valleys and rounded ridges, and the Canberra plains, in a "more mature stage of erosion." Mr. Taylor dealt not only with the geography but briefly with the political considerations which dictated the choice of the site. It fortunately happens that political and geographical considerations coincide, for Mr. Taylor showed how the federal territory is situated on "a line joining the centre of population with the nearest good port," namely Jervis Bay, where the seaport of the new city will be situated. Mr. Taylor described the physical environment of the territory, and incidentally mentioned conditions affecting south-eastern Australia as a whole; he drew an effective comparison between this country and the United States of America, having regard to the points in the history of their settlement and development which each has reached.

DURING the Christmas holidays the Lawes and Gilbert Centenary Fund Committee ceased work so as not to interfere with the ordinary Christmas appeals; it has now begun work again to collect the last 1600*l.* needed to complete the scheme. The object of the centenary fund is to build and equip a satisfactory laboratory for the prosecution of researches in agricultural chemistry, a subject largely founded on the experiments of Lawes, who was born just 100 years ago, and of Gilbert, who was born three years later. These investigators founded the Rothamsted Experimental Station, the oldest, and for many years the best-equipped agricultural experiment station in the world. Rothamsted has maintained its high position in respect of its staff and its field plots, but it has fallen behind in laboratory accommodation, and a serious effort is now being made to remedy this defect. The committee has ascertained that a satisfactory laboratory can be erected and equipped for 12,000*l.*, and it has decided to collect the money, and to put up the laboratory this year in commemoration of the centenary of the birth of the founders. Its efforts have been so far successful that only 1600*l.* is now required; and an urgent appeal is addressed to all interested in agricultural science to aid the committee in closing the list so that the work can be put in hand at an early date. Subscriptions should be sent to the secretary, Rothamsted Experimental Station, Harpenden, Herts.

SIR HERBERT MAXWELL, in a letter to *The Times* of December 10, throws doubt upon a cherished belief of fly-fishermen. Great care is taken by salmon-fishers in the selection of their flies, which are formed by tackle-makers with rare and bright feathers supposed to be particularly attractive to the fish. As a fisherman with more than fifty years' experience of the habits of salmon in many rivers, and as an observant naturalist, Sir Herbert states that he has failed to detect the slightest preference on the part of salmon for one pattern of fly over another. He adds: "I should be perfectly willing, during the few angling seasons which may remain to me, to use no flies except those composed of the feathers of native game birds or barndoor fowls, dyed or undyed, with silk and tinsel to smarten them up to human, if not to piscine, taste." It has been stated that a large number of beautiful birds are sacrificed every year to the demands of fishermen for brilliantly coloured artificial flies. The demand is based upon the assumption that a salmon is capable of discerning details of form and colour in a small object passing between its eye and the high light; although a human eye, in a similar relative position, could perceive nothing but a dark silhouette. According to Sir Herbert's observations, the colour and material of the lures used are of little consequence; and if this be the case, the destruction of numerous brightly plumaged birds in order to provide feathers for artificial flies is not only useless, but also a waste of beauty.

COMMENDATORE BONI has made another notable discovery in the course of his excavations on the Palatine Hill at Rome. He has found the famous *mundus*, or pit, leading to the infernal regions, sacred to Dis and Proserpine. This was covered by the *lapis manalis*, a square, rough-hewn slab of tufa pierced by two round holes. It was the innermost shrine, the most holy centre of the Roman religion, consecrated to the ancient mysteries, whence germinated and spread forth the fundamental energies of the Roman people. The later Romans had lost the site of this sacred spot, and the Emperor Augustus, in his desire to re-establish the ancient usages, searched for it in vain. A shaft, filled with débris, discovered in the course of recent digging, may well represent the exploration by Augustus.

A JOURNAL dealing with Egyptian antiquities has long been needed. We are glad to welcome the appearance of a new quarterly magazine, having the title, *Ancient Egypt*, which, under the editorship of Prof. Flinders Petrie, promises to supply the want. The first issue is well printed and illustrated, contains much interesting matter, and is procurable at the modest cost of 7*s.* per annum. Prof. Petrie notices an interesting fact about early glass manufacture. Sir Gardner Wilkinson ("Manners and Customs," ed. 1878, Fig. 380) published a drawing supposed to represent men blowing glass bulbs on the end of rods. But though examples of early glass, especially about 1500–1400 B.C., are abundant, not a single piece of blown glass can be dated before Roman times. The men are really using reed blowpipes for a jeweller's furnace, and as these blowpipes would soon be burnt at the end, a lump of mud was put on as a nozzle to the pipe. The new journal is published by Messrs. Macmillan and Co., Ltd.

IT will be remembered that the eighteenth International Congress of Americanists was held in London during May, 1912. Two articles appeared in NATURE dealing with the congress; one on April 18, 1912 (vol. lxxxix., p. 169), gave the outstanding items of the programme, and the other on June 6, 1912 (vol. lxxix., p. 379), summarised the proceedings. The editorial committee has now issued in two volumes running to 570 quarto pages (London: Harrison and Sons, 2*l.* 2*s.* net) the full proceedings of the session. Full lists are included of the names of the officers, organising committee, delegates, members, and associates. The presidential address of Sir Clements Markham and the papers read in the various sections are given in full, and many of the latter are handsomely and profusely illustrated. The success of the congress must be very gratifying to Sir Clements Markham, Dr. A. C. Haddon, and Mr. A. P. Maudslay, to whom the organisation and arrangements were entrusted.

In the number of *Biometrika* issued in October, 1913, Dr. H. S. Stannus describes cases of albinism or deficiency of pigment in natives of Nyasaland. He classifies them into several groups, ranging from complete albinism to a condition in which the skin is light brown, the hair yellow, and the irides hazel, and also separates off three distinct groups of piebalds and "spotlings." He also describes cases of pathological leucoderma, and discusses its relation with albinism. The descriptions indicate that there is considerable grading between the different classes; the examples classed as complete albinos have some pigment in the fundus and iris, and there seems to be no sharp line of distinction between these and cases with pigment in the skin. The more extreme cases are often associated with bad teeth. The short pedigrees given show no instance of direct transmission from parent to child, but several of more than one case in a family.

In *The Field* of December 13, 1913, Mr. Lydekker adduces evidence to show that the Circassian goat may be a domesticated derivative from the markhor (*Capra falconeri*), which it resembles in the direction of its horn-spirals, and thereby differs from other domesticated goats—the offspring of the wild *C. hircus aegagrus*.

In the Proceedings of the U.S. National Museum, vol. xlv., pp. 651–57, Dr. F. W. True describes a new species of beaked whale from the Californian coast, under the name of *Mesoplodon mirum*, a preliminary diagnosis having been given in an earlier note. The species is related to Sowerby's beaked whale (*M. bidens*), and also to *M. europaeus*, from the latter of which it differed by the form of the beak and of certain other elements of the skull.

The new generic and specific name, *Leurospondylus ultimus* is proposed by Mr. Barnum Brown (Bull. Amer. Mus. Nat. Hist., vol. xxxii., pp. 605–15) for a plesiosaurian from the Upper Cretaceous Edmonton beds of Alberta, Canada, which is of special interest on account of being the latest member of its order at present known. It was a relatively small species, the vertebral column measuring about 7 ft., and related to Elasmosaurus, among its distinctive features being the medium length of the neck, the shortness and width of the centre of the vertebræ, and the single-headed ribs.

In an article on the inheritance of left-handedness in the *American Naturalist* for December, 1913, Prof. F. Ramaley points out that the peculiarity, in its true form (*i.e.* when not acquired), seems to be connected with an unusually high development of the right cerebral hemisphere. As the result of the record of 1740 cases, of which 610 were parents, it is concluded that as regards inheritance, left-handedness is a Mendelian recessive. Out of 305 families there were only two in which both parents were left-handed, and in one of these one of the three children was right-handed, whereas if the inheritance were recessive all should have been left-handed. A possible explanation of the anomaly is that one of the parents was naturally right-handed.

To the large number of extinct bisons from the superficial formations of North America already described as distinct species, Dr. O. P. Hay, in a paper published in the Proceedings of the U.S. National Museum, vol. xlvi, pp. 161–200, adds a new one, under the name of *Bison regius*. It is typified by a skull discovered in 1902 near Hoxie, Sheridan County, Kansas, and appears to be nearly related to *B. latifrons*, of Ohio, from which it differs by the greater length, slenderness, and curvature of the horns, and also by the folding of the enamel of the central pits in the crowns of the upper molars. The latter feature is the one on which the author chiefly relies in distinguishing the new species from *B. latifrons*, as the difference in the horn-cores might be merely sexual. The paper, which is illustrated by eleven plates, also contains a synopsis of all the other species, with a "key" to their distinctive features. In a second paper the same author (*op. cit.*, pp. 267–77) recognises seven species of the North American Pleistocene genus Camelops, and at the same time discusses the characters distinguishing this genus from the existing Lama (Auchenia), with which it has been regarded by some writers as identical. Among the more important differences are the absence of a vertical ridge at the antero-external angles of the last two lower molars of Camelops, the longer and narrower skull, the more elongated grinding surfaces of the upper molars, the more procumbent lower incisors, and the narrower upper portion of the nasal bones of the skull.

We have received a reprint of a paper from *The Salmon and Trout Magazine*, July, 1913, by Mr. J. Arthur Hutton, on Wye salmon (results of scale reading, 1908 to 1912), in which the author gives numerous statistics of the length, girth, weight, &c., of a considerable number of salmon caught each year, together with some information as to age and spawning, as shown by examination of the scales of the fish. Work of this character is most valuable from the point of view of the study of the life-history of the fish, and it would lead to a considerable increase of our scientific knowledge of the salmon if fishermen would make similar observations on the fish of other British rivers. One of the most interesting results brought out by Mr. Hutton's figures is that the proportion of girth to length of Wye salmon, which may be regarded as a measure of the condition of the fish, is highest (0·523) in fish netted at the mouth of the river, whilst it gradually decreases in fish taken in the higher waters, until it sinks to 0·497 in those salmon caught above Builth, which is 115 miles from the sea.

Miss Doris Mackinnon contributes to the *Quarterly Journal of Microscopical Science* (vol. lix., part 3) some interesting notes on certain flagellate Protozoa found in the intestine of the common leather-jacket, or larval crane-fly. It appears that no fewer than eight kinds of flagellates and two amœbæ are found in this situation, feeding upon a rich bacterial flora. The author suggests that the term "parasite" is scarcely applicable to such organisms, which appear to fulfil a useful function in keeping down the bacteria, and points out that the richest intestinal fauna was generally found in the largest and healthiest looking grubs. She believes that totally different species of animals, when they frequent the same feeding grounds, may serve as hosts to the same species of protozoan parasites. The beautiful form known as *Rhizomastix gracilis* was described by Alexeieff in 1912 from the Axolotl, and Miss Mackinnon now records and figures it from the crane-fly larva, filling in certain particulars as to its life-cycle. A new subgenus and species, *Tetratrichomastix parisii*, is proposed for another flagellate from the same host, the subgeneric name being chosen on analogy with Tetratrichomonas. It is true that Tetratrichomonas possesses an undulating membrane which may represent a fifth flagellum, but the fact that five separate flagella are actually present in the new subgenus makes the proposed name distinctly misleading.

THE rust-fungi (Uredineæ) of Nova Scotia are dealt with in detail by W. P. Fraser in vol. xii., part 4, of the Proceedings of the Nova Scotian Institute of Science. The author gives an excellent introductory account of the structure and life-history of the group, followed by detailed descriptions of the ninety-two species known from Nova Scotia, including several not hitherto found in any other part of North America. In the descriptions the terminology proposed by Arthur in his well-known work on North American Uredineæ is followed, though it is doubtful whether botanists in general will perceive any special advantage in the new terms adopted for the various pore-forms in place of those which have become familiar by long usage.

A VALUABLE contribution to our knowledge of soil gases and the complex conditions surrounding the growth of crops in swamp rice soils has been made in the Memoirs of the Department of Agriculture in India, vol. iii., No. 3, chemical series, by Mr. W. H. Harrison and Subramania Aiyer. The results obtained show that the normal fermentation of green manure in swamp paddy soils leads to the production of a relatively large quantity of methane, a smaller amount of nitrogen, together with some carbon dioxide and hydrogen. This in itself is not surprising when one considers the anaerobic conditions obtaining in the flooded soil, but it has been further observed that the introduction of a crop greatly modifies the composition of the soil gases, either by directly retarding the rate of fermentation and restricting the formation of methane and hydrogen, or by a portion of the intermediate products of decomposition being removed out of action by absorption by the roots. The latter has been experimentally demonstrated in various recent investigations, and the nutrition of paddy rice would appear to consist in the assimilation of nitrogen either in the form of ammonia or of organic compounds produced by the decomposition of the proteids of the green manure, since nitrification is impossible under the anaerobic conditions that obtain in these soils.

THOSE who desire to keep pace with modern views on crust-displacements and mountain-structure, whether as an aid to geographical or geological studies, will find a well-illustrated summary in Otto Wilckens's "Grundzüge der tektonischen Geologie" (Jena: G. Fischer; price 3.50 marks), which covers matters that are not to be found in every text-book.

THE Government Printing Office at Kingston, Jamaica, has issued a coloured geological map of Jamaica, which may be found generally useful, on the scale of one inch to twenty miles. It is published separately as Publication No. 420, with an explanation by Maxwell Hall, but might be overlooked by geologists, since it officially forms part of the memoir on "The Rainfall of Jamaica from about 1870 to end of 1909."

THE Cotteswold Naturalists' Field Club maintains its reputation for original publication in its eighteenth volume (1913). L. Richardson and C. Upton describe new species of brachiopods from the Inferior Oolite, and the former author, with E. T. Paris, publishes a supplement to previous work on the echinoids from the same formation. The photographs of important species are in both cases admirable. The country where William Smith found such welcoming friends as Benjamin Richardson and Joseph Townsend will never forget the principles of stratigraphical geology.

"A BIBLIOGRAPHY of Russian Ethnographical Literature" forms vol. xl., No. 1, of the *Zapiski* of the ethnographical section of the Russian Geographical Society. It covers the years 1700 to 1910, and is compiled by M. D. K. Zelenin on behalf of the Commission for the Construction of an Ethnographical Map of Russia.

PROF. KUZNETSOF, whose historical sketch of the flora of Daghestan has already been referred to in these pages (vol. lxxxviii., p. 600), gives an account of his investigations and results in the *Izvestiya* of the Russian Geographical Society, Nos. i.–iii., 1913. At the end of the number is a map showing the distribution of the most distinctive forms, and a full list, compiled by M. P. P. Popof, of the plants collected.

THE narrative of M. Zhitkof, who explored the Yamal Peninsula, in 1908, is published in the *Zapiski* of the Russian Geographical Society, vol. xlix. The name Yamal, meaning "end of the earth," in the Samoyed language, is more correct than the usual Yalmal, which signifies "mouth of the river" (Ob). The country is low, especially in the north, where it slopes down to the Malygin strait, and the watershed is there inconspicuous. In the south it is more marked, rising at the Yarro-to lakes to 300 ft. above sea-level. The eastern and western coasts often rise in steep cliffs of clay and sand. Lakes and basins partially filled up are numerous in the central part. The work includes chapters on the fauna and flora, the Samoyeds and reindeer grazing. M. Rudovits contributes a report on the meteorological observations, and General Shokalski on the hypsometrical determinations. The volume contains numerous illustrations, a map of the peninsula, and one of the lakes Noi-to and Yambu-to, from a survey by Captain Vvedenski.

In the last annual report of the Meteorological Committee it was stated that, at the request of H.M. Treasury, the committee had entered into negotiations with the Scottish Meteorological Society with the object of placing the finances of the latter upon a satisfactory footing as regards the supply of information to the public generally, and of securing a closer cooperation with the Meteorological Office in respect of climatological stations in Scotland. The Journal of the society (vol. xvi.), and the last report of the council to the general meeting of the society, show that the financial position of the latter had long caused great anxiety, the only additions to its ordinary income (derived chiefly from decreasing voluntary sources), being small annual payments for observations by the Registrar-General (Scotland) and the Meteorological Committee. A strongly supported appeal to the Treasury ultimately resulted in the action above referred to, and we are glad to find that the deliberations between the various authorities interested have been crowned with success. The amount hitherto paid by the Meteorological Committee is very materially increased (from April 1, 1913), and that paid by the Registrar-General will be continued. A Meteorological Office has been established in Edinburgh, the organisation of the supply of information on the lines above-mentioned has been secured, and the arrangements are considered to be "in the best interests of meteorology and of the society." The public funds will be administered by a representative committee (including several members of the society), with Dr. W. N. Shaw as chairman.

A careful examination of the effects of temperature on the physical properties of a number of minerals has been undertaken by the geophysical laboratory of the Bureau of Standards. The first communication dealing with the results obtained, appears in the Journal of the Washington Academy of Sciences for December 4, and is devoted to the measurements of the change in the crystal angles of quartz made by Mr. F. E. Wright at temperatures between 0° C. and 1250° C., with a special two-circle goniometer constructed for the laboratory. The author finds that the polar angle for the unit rhombohedron (1011) decreases from 51° 47·5′ at 0° C. to 51° 37′ at 575° C., the quartz then changes from the α to the β form, and the angle becomes 51° 35′ and remains constant up to 1250° C. The agreement between these observations and those of Randall on the expansion of quartz, those of Sosman on its specific volume, and the tabulated values of its birefringence is very close over the range 0° C. to 550° C.

We have received copies of Nos. 5 and 6 of the *Publications de la Société de Chimie-Physique*, issued by the Librairie Scientifique A. Hermann et Fils, Paris. No. 5 is entitled "L'Etude physico-chimique des sels chromiques," by M. A. Sénéchal (pp. 28, price 2 francs), and No. 6 "L'additivité des propriétés diamagnetiques et son utilisation dans la recherche des constitutions," by M. Paul Pascal (pp. 26, price 1 franc). These form part of the useful series of monographs issued by the society, and were originally delivered as lectures before the members.

In the *Sitzungsberichte* of the Imperial Academy of Sciences, Vienna (vol. cxxii., class ii. b, p. 75), Messrs. V. Rothmund and A. Burgstaller describe a method for the estimation of ozone and hydrogen peroxide in presence of each other, for which purpose no accurate method is yet known. Advantage is taken of the fact that, by the addition of a trace of molybdic acid, it becomes possible accurately to determine hydrogen peroxide iodometrically. Difficulties are encountered in estimating ozone directly in a similar manner, but by adding potassium bromide under certain defined conditions, and subsequently potassium iodide, iodine is liberated quantitatively, and the two methods can be combined so as accurately to estimate both substances.

The presidential address delivered to the American Chemical Society at Rochester, N.Y., by Mr. A. D. Little, is reprinted in *Science* (vol. xxxviii., No. 984), under the title, "Industrial Research in America." Mr. Little points out that although Germany has long been regarded as pre-eminently the country of organised research, a new competitor is arising in the United States, "that prodigal among nations, still justly stigmatised as the most wasteful, careless, and improvident of them all." Within the last few years enormous funds have been allotted to the organisation of research in a large number of the principal industrial concerns of the United States, and a very striking account is given of some of the most important achievements of this new system. "Research has firmly established itself among the foundation-stones of our industrial system, and the question is no longer 'What will become of the chemists?' It is now, 'What will become of the manufacturers without them?'" There are in the United States at least fifty notable laboratories engaged in industrial research for private companies, in several of which the expenditure is more than 300,000 dollars a year. An interesting summary is given of the activities of Government departments, such as the Department of Agriculture, the Bureau of Mines, and the Bureau of Standards of the Department of Commerce, which alone devotes about 700,000 dollars annually to scientific work.

The Engineer for January 9 has an illustrated article on the motor ship *Fionia*, the largest and highest powered ship of this kind in service. This vessel is the ninth motor ship built by Messrs. Burmeister and Wain, of Copenhagen, and is 395 ft. long, with a dead-weight capacity of 7000 tons. She is propelled by two sets of Diesel engines, having a combined horse-power of 4000. Each set has six cylinders as compared with eight in earlier ships, and the cylinder sizes have been increased from 530 mm. diameter and 730 mm. stroke to 740 mm. diameter and 1100 mm. stroke. The speed has been reduced from 135 to 100 revolutions per minute. The *Fionia* ran her official trials in Copenhagen Sound on December 18 with uniformly favourable results.

An article in *Engineering* for January 9 directs attention to the waning supply of petroleum. Although a continually greater supply of petroleum is being placed on the market, this increased output is secured only by sinking more wells and boring to a greater depth, showing that the surface supply is becoming exhausted. At the beginning of this century the wells touched 1100 ft., and to-day the average level of the oil may be placed at 2000 ft.—an ominously rapid rate of sinking. Dissatisfaction with existing methods and acute appreciation of the necessity for increased effort to keep up the yield have induced the United States Bureau of Mines to issue a warning, and to suggest improved methods of working. It cannot but be regarded as a happy augury that the authorities are alive to the extent of the drain made on the stores of oil, and of the necessity of husbanding the resources of the future. America, by reckless expenditure of her resources, has increased her annual output to 200 million barrels, yet the demand for oil for special purposes has become so great that the rise in price is considerable—so great, indeed, that competition with coal for ordinary purposes has become impossible. The entire production of petroleum from all sources is only about one-fifth of the coal produced in England alone, and already schemes are on foot for obtaining a motor fuel from other sources.

The issue of "Willing's Press Guide" for 1914 is the forty-first to appear. The first 297 pages are devoted to an alphabetical list of newspapers and periodicals. Among other useful contents may be mentioned the classified list of the periodical Press of the United Kingdom according to the interest or subject dealt with, and the lists of metropolitan newspapers, the provincial Press, and American newspapers.

OUR ASTRONOMICAL COLUMN.

Comet 1913*f* (Delavan).—This comet is gradually creeping up in north declination and getting brighter. The following is an ephemeris for intervals of four days:—

Berlin Midnight.

		R.A. h. m. s.		Dec. ° ′
Jan. 12	...	2 53 25	...	−2 1
16	...	2 54 58	...	−0 36
20	...	2 57 30	...	+0 59
24	...	3 1 3	...	+2 43
28	...	3 5 40	...	+4 36

The Crossley Reflector and Nebulæ.—Mr. Heber D. Curtis contributes to the Lick Observatory Bulletin, No. 248, a second list of nebulæ and clusters photographed with the Crossley reflector, being a continuation of that which appeared in Bulletin No. 219. It comprises photographs secured between September 26, 1912, and November 1, 1913. The exposures were practically all of two hours' duration, but the author states that longer exposures and counts limited to a radius of 15′ from the optical axis might easily show larger number of nebulæ per square degree. The present list comprises descriptions of 109 nebulæ and clusters, and many uncatalogued nebulæ which present features of interest are included. The list is striking in that on some plates such a large number of nebulæ was photographed. Thus under N.G.C. 20 it is stated that there are forty-one nebulæ on this plate; under N.G.C. 68 eighty-seven were counted in an area of 45′×55′; on other plates we find 30, 31, 37, 31, 36, 28, 47, 69, 28, 17, nebulæ recorded.

Galactic Coordinates.—The *South African Journal of Science* for November last (vol. x., No. 3) contains a communication from Mr. R. T. A. Innes, advocating the use of galactic coordinates for star positions. The adoption of fixed instead of moving coordinates is an object much to be desired, and it would eliminate a great amount of labour if such a system could be adopted. Regarding the adoption of the galactic plane as a point of departure for measurement the galaxy is so irregular that estimates of the great circle which most truly represents it do not agree among themselves. Mr. Innes thinks, however, that such criticism is superficial. Mr. Crommelin (*Knowledge*, January) points out that both the galactic circle and the suggested starting point, the longitude of the sun's apex, are arbitrary, and that "it would be exceedingly difficult to get the astronomers of all nations to agree on points of this kind." Further, he suggests that it is likely that for a long time to come meridian instruments will be the chief means of obtaining the places of at least the brighter stars, so that the R.A.'s and declinations will still have to be found. Mr. Innes's paper is nevertheless an interesting and suggestive contribution.

The Arc Spectrum of Iron.—Lick Observatory Bulletin, No. 247, is devoted to an investigation on the arc spectrum of iron carried out by Mr. Keivin Burns at the Physical Institute at Bonn at the suggestion of Prof. Kayser. The object was to measure with reasonable accuracy all the lines of the arc spectrum of iron which can be readily photographed. It was proposed to measure the stronger lines on four plates each and the fainter on two plates. This programme has been completed for the region 3206–7800 A, but for various reasons shorter and longer wave-lengths than the above are excluded. The apparatus used was a Rowland concave grating mounted according to Abney's method—that is, the slit is the only movable part of the apparatus. The author describes the plates used, the standards employed, and the method of measurement and reduction, and accompanies his communications with the long list of wave-lengths derived. In comparing his results with those of Goos, he finds that the differences, Burns minus Goos, are usually less than 0·004 A, limiting the comparison to lines about equal in intensity to the standards. Other lines, he says, do not agree so well. Referring to the Mount Wilson measures, he writes:—"My measures are in good agreement with the values of St. John and Ware, in the case of lines for which these observers find the same wave-length on Mount Wilson as in Pasadena. In cases where they find a difference between the mountain- and sea-level, my measures are in excellent agreement with the wave-lengths found on the mountain, although my observations were made at sea-level." The author again directs attention to the systematic differences of wave-lengths or displacements with regard to the lines of impurities, a subject referred to in this column on August 7 of last year (vol xci., p. 592). He here asks the question: "Will the wave-length of a line in the carbon arc be different from the wave-length of the same line at the same pressure in the iron arc?" The answer may not be so easy to give correctly as it appears to be.

EDUCATIONAL CONFERENCES.

THE annual Conference of Educational Associations just concluded at the University of London was a strenuous business spread over eight days. The inaugural address by Mr. James Bryce contained a plea that the strongest and finest minds should be pushed forward. In reference to this key to national success, it was noted that the tide runs now towards scientific studies just as fifty years ago it ran towards humanistic studies, and it was pertinently asked: What subjects and what sort of teaching of those subjects, are best calculated to train men to think, to enable the mind to see facts as they are, to analyse them, to draw just conclusions from them, to rise above prejudices, to play freely round the phenomena of life? Are mathematics and physics or chemistry sufficient for this purpose? The note of caution here applied in one direction was also sounded in connection with the additional expenditure of public money on education, with a single exception, that concerning the payment of higher salaries to the teachers.

This same note of caution was noticeable in many of the speeches made both at the London conference and at the North of England Education Conference. The London paper, by Sir H. G. Fordham, on the problem of rural education opened with the reminder that so great has been the effect of modern methods of locomotion upon the movement of population, "there is nothing to be gained by attempting to make an educational distinction between the town man and the country man." Agriculture, he asserted, can, in no circumstances, be usefully introduced as a subject of instruction in elementary schools, and can only very indirectly be utilised as a subject of instruction in secondary schools.

Sir Robert Baden-Powell dealt with character building in schools, and, after asserting that the Scout movement had captured the boys, truly laid his monitory finger on one of the defects of the Scout movement; it has not captured the teacher. Theoretically, the movement is good; how often does it fail because the teachers are not scout-masters?

Mr. H. Holman warned us that manual teaching was not going to transform education, however much it would reform it. It was not going to do away with reading, writing, and arithmetic, but it would deprive them of their usurped and false pre-eminence. These subjects would be better taught.

In the north of England Dr. M. E. Sadler reverted to the review of education made by Principal Griffiths in his presidential address to the Educational Science Section of the British Association. In Dr. Sadler's opinion English education is at the moment torn asunder by hesitancy as to ideals. It is puzzled, self-critical, harried by doubts. It is frightened of making a venture. But there is encouragement in this condition; for the hesitation is the outcome, not of palsied will-power, but of harrassed fair-mindedness; and there are signs that a clear purpose is taking the place of this uncertainty.

Consequently, the Geographical Association can be congratulated upon its definite successes. This year the association attained its majority, and Dr. Scott Keltie has become the president of the association thirty years after his issue of the famous report on geographical education. Dr. Keltie's *résumé* of thirty years' progress was distinctly exhilarating. Geography has a definite place in education, and its sphere of labour is by no means circumscribed; the plan is in being, and the stately edifice is being erected.

A definite aim in education emerges from these conferences in reference to examinations. On many occasions expression was given to the opinion that the written examinations, which Dr. Rouse labelled as the fetish of the British people for sixty years, required the definite addition of a face-to-face test. In connection with the examination of modern languages, a rough equivalent of the face-to-face test, viz. free composition, was stated to be showing beneficial results.

The meeting of the Private Schools Association in London was notable for the severe criticism levelled at the Board of Education. The Rev. G. H. Moore said that the Board had displayed such despotism that at times it might seem to be anxious even to deprive the parent of the choice of school for his own children. A single inspector's opinion came with the whole weight of the Board behind it. The reputation of a teacher could be ruined in an hour by his inability to satisfy the standard of the Board's inspector of the moment.

The Montessori system was treated cautiously in the north and ambitiously in London. The title of the paper read in London is significant, "The New Hopes Due to Scientific Investigation of the Child's Natural Development." The London speakers revelled in their proclamation of a new scientific method, and, therefore, of a new science of experimental psychology. The Montessori system was claimed as the application, for the first time in the world's history, of science to the problems of education. The system applies the laws of environment which are more powerful than the laws of birth; no more than 1 per cent. of young children are hopelessly inefficient from birth; on the basis of an experience of a few brief years and in reference to these young children, it was claimed that a class of forty children trained on the Montessori system became a class of forty efficient children without a single backward or stupid scholar. The caution which was absent on this occasion from the speeches in London must have risen to the minds of the teachers present as they heard acclaimed as new those methods of pedagogy which most good teachers have long practised, *e.g.* waiting until the pupil is ready before giving a lesson on a new subject. Teachers know they must so wait; but owing to the fact that they teach classes, they cannot wait for all individuals; hence the novelty lies solely in individual instruction.

In the north stress was laid on the need for caution in regard to the Montessori apparatus. There seems to be a very real danger in the overbalance of minute, isolated sense training, against the minimum of story-telling, of play, and happy dancing and singing. In relation to the Montessori principle of auto-education, of freedom, it was asked with due reason, "But should not the apparatus give scope, so that it helps him at five years old to become aware of his neighbour? For this apparatus offers little, if any, scope for neighbourliness." Similarly, the system demands that the child shall not be made aware that he has made a mistake. Is it not wise to realise that an intelligent failure is more hopeful for the future than an unintelligent success? There is some hope in class-teaching after all.

RHEOSTATS.

AN example of the great attention given to details nowadays in connection with apparatus for the laboratory and lecture-room use, and general experimental work, is afforded by a 104 pp. list which a firm of electrical instrument makers (Messrs. Isenthal and Co.) have sent us, devoted entirely to rheostats. It is not within the scope of the present article to indicate all the various patterns and modifications of these, but we may mention that we notice among the designs some convenient "twin" and "universal" patterns which enable a large range of resistance and accurate regulation to be obtained with apparatus of smaller dimensions than a simple rheostat would have for the same requirements. The catalogue contains a diagram of the "Ruhstrat" winding, designed to eliminate, so far as possible,

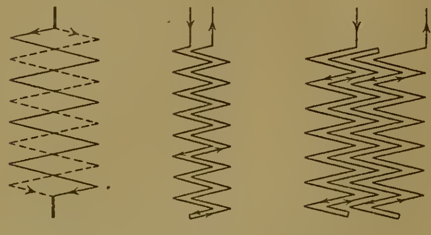

FIG. 1—Ruhstrat winding. FIG. 2—Ordinary double winding. FIG. 3.—Chaperon winding.

capacity and safe induction. Two wires are wound in parallel in opposite directions and symmetrically, as shown in Fig. 1, which may be compared with the ordinary double winding shown in Fig. 2, and the Chaperon winding in Fig. 3.

The idea used to prevail that practically anything would "do" to insert as a resistance for reducing the voltage of the supply mains for experimental work or various miscellaneous purposes. This has resulted in trouble from time to time, and more care is now exercised in the selection of suitable pieces of apparatus. One form of rheostat, for instance, which was at one time extensively used in connection with medical applications of electricity, has a particular element of danger. It was customary to use a coil of very fine wire wound on slate connected as a potentiometer between two supply mains, as shown in Fig. 4; an apparently small and easily adjustable difference of potential is thus obtained between the points A and B, but the danger is that if the part of the rheostat wire between these two points should burn out, the pressure between A and B will suddenly rise to the full 220 volts.

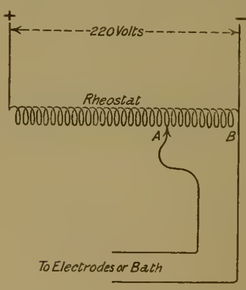

FIG. 4.

Another method of applying such a rheostat is shown in Fig. 5 in connection with an electric bath. The bath, of course, is porcelain. The main resistance in the circuit in this case is the lamp B, so that the current passing through the bath can be adjusted with considerable accuracy by moving the slider along the rheostat, and in ordinary circumstances the potential difference between the two electrodes in the bath is not high. It must be remembered, however, that if the two points A and D are connected across the supply mains, one of these will be at earth potential. If this is the point A it is evident that the point D, which is directly connected to one of the electrodes, is actually at 220 volts potential, and a patient sitting in the bath and touching a water tap would immediately receive a 220-volt shock. If the connections between the rheostat board and the electric lighting mains are made through an ordinary two-pin plug, as shown in the diagram, it is an even chance whether this wrong connection is obtained or not. A similar shock could be obtained, no matter what was the polarity of the connections if the lamp were to become short circuited.

For heavy currents proper precautions must also be taken in the construction of rheostats. If, say, a 20-ampere arc lamp for a high-power lantern projector is used from a 220-volt main, it necessitates the use of a resistance which shall cause a drop of about 170 volts, *i.e.* the consumption of power of $170 \times 20 = 3400$ watts, or about $4\frac{1}{2}$ h.p. If wire of sufficient thickness is not used, this will rise to a very high temperature, and, no matter what the gauge of the wire, it is clear that if the lamp is used for a long period at a time a very large amount of heat has to be dissipated. The wiring rules of the

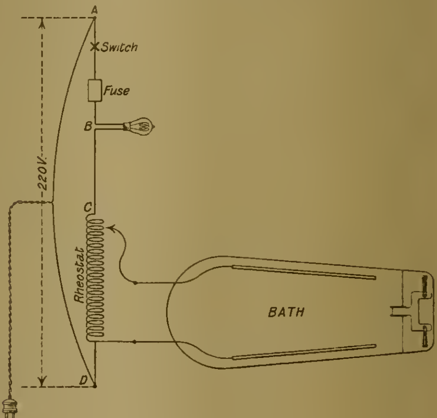

FIG. 5.

Institution of Electrical Engineers, which unfortunately are not always observed in such cases, limit the maximum temperature of the case containing the resistance to 176° F. (80° C.). The rules also specify that the resistances must be enclosed in cases of incombustible material, or protected by wire gauze or perforated sheet metal, and fixed so that no unprotected combustible material is within 24 in. vertically above the case, or within 6 in. in other directions.

Largely owing to the development of apparatus for electric cooking, considerable progress has also been made in recent years in the composition of the wire itself. For cases in which large currents are employed, wires made of special alloys have been produced which will stand a very high temperature without oxidising or becoming brittle. It is true that when a constant resistance, practically independent of temperature, is required, such alloys may not always be suitable, but for heavy current work, such as indicated above, they can naturally be used with considerable advantage. In the mechanical construction of resistances, great progress has also been made.

MODERN METHODS OF MEASURING TEMPERATURES.[1]

THERE are few manufacturing processes in which the question of temperature is not involved, and it may be of use to review briefly the methods now available for the measurement of temperatures.

As a result of the work of Guillaume,[2] Chree,[3] the Physikalische Technische Reichsanstalt, and others, the mercury thermometer has become an instrument of considerable precision. Hard glasses such as the French *verre dur* and the Jena glasses 16$^{\text{iii}}$ and 59$^{\text{iii}}$, are now used almost universally for making at least the bulbs of the best thermometers. In all mercury thermometers intended for accurate work the two fundamental points (0° and 100° C.) are introduced whatever may be the range of the thermometer; this is done by making small enlargements in the capillary.

Assuming that such a thermometer has been properly constructed and its corrections determined at one of the National Physical Laboratories, it is possible to measure temperatures with it to an accuracy of 0·001° C., throughout its range.

For nearly all engineering work an accuracy of 0·001° C. is not required,[4] and the recent developments in mercury thermometers have been in the direction of making them easier to read[5] and more robust. The introduction of an inert gas under pressure above the surface of the mercury in the tube of the thermometer raises the temperature at which the mercury boils, thus permitting the thermometer to be used up to a temperature of 540° C., this limit of temperature being due to the softening of the glass envelope.

Thermometers of various kinds have been developed in which metal tubes have been substituted for the glass envelope, and gases, saturated vapours, or liquids for the mercury. Mercury-in-steel instruments are proving themselves very practical instruments in engineering work. They consist of a steel bulb to which a steel capillary tube is attached, the latter being connected to a form of Bourdon pressure-gauge. The whole system is filled with mercury and hermetically sealed. The hand, attached through some simple mechanism to the pressure gauge, is arranged to point over a dial or to carry a pen which writes on a circular sheet of paper rotated by clockwork. The recording or indicating mechanism may be placed at distances up to 75 ft. from the bulb of the thermometer.

Thermo-electric Thermometers.

Expansion thermometers have a limited range of temperature over which they may be employed, and some of the other physical properties of materials must be used for the determination of high temperatures. The most valuable for this purpose is the property by which a thermo-electric force is set up when a junction of two dissimilar metals is heated when this heated junction forms part of a closed circuit, the magnitude of the current and its direction depending on the metals employed. Le Chatelier showed that platinum, platinum-rhodium (10 per cent. Rh) was the most satisfactory of all thermo-elements, and this has been generally adopted as the standard couple. Owing to the high price of platinum many attempts have been made to find satisfactory thermo-couples made of comparatively inexpensive wires.

The most satisfactory of these so-called "base" metal couples is silver-constantan (the latter being an alloy wire sold commercially as a resistance material, and consisting of copper 60 per cent., nickel 40 per cent.), and it may be employed up to 700° C. Copper is frequently used instead of silver as one element of this couple, but in practice it will not be found so trustworthy as silver for temperatures above 500° C.

For temperatures from 700° C. to 1100° C. the Hoskin's couple, which consists of nickel used in conjunction with nickel-chromium (10 per cent. Cr) may be employed.

The electromotive forces given by various thermo-couples differ very much, as the following table will show. In each case the cold junction temperature is 0° C.

Name of thermo-couple	Approximate electromotive force in millivolts at 500° C.
Platinum-platinum, 10 per cent. rhodium	4·4
Platinum-platinum, 10 per cent. iridium	7·4
Nickel-nickel, 10 per cent. chromium (the Hoskin's couple) ...	10·0
Iron-nickel	12·0
Iron-constantan	26·7
Silver-constantan	27·6
Copper-constantan	27·8

The relation between temperature and the E.M.F. produced by a thermo-couple when the cold junction is maintained at 0° C. is given by Holman's empirical formula[6]:—

$$\log E = A \log t + B,$$

when E = E.M.F. of the thermo-couple in microvolts; t = the temperature of the thermo-couple in degrees Centigrade, and A and B are constants depending on the wires employed. For the chief thermo-couples in general use at the present time this equation is as follows:—

Platinum, platinum-rhodium, approximately $\log E = 1{\cdot}19 \log t + 0{\cdot}52$.

Platinum, platinum-iridium, approximately $\log E = 1{\cdot}10 \log t + 0{\cdot}89$.

Silver-constantan, approximately $\log E = 1{\cdot}14 \log t + 1{\cdot}34$.

In accurate thermo-electric work the universal practice is to immerse the cold junction of the thermo-couple in melting ice and to adopt the potentiometric method of measuring the electromotive force given. In industrial practice the E.M.F. is measured directly by a galvanometer, which should be placed in a spot which is not subject to great variations in temperature. It is only necessary, therefore, to run the wires from the hot end of the thermo-couple straight to the galvanometer, and this is the course generally followed in the case of the base metal couples. Owing to the costliness of the material, it is impossible to do this with platinum couples, and several proposals have been made to overcome this difficulty. The most satisfactory method is one originally due to Bristol,[7] but suggested independently by Peake,[8] in which an inexpensive alloy is substituted for the platinum wires, the alloy being so chosen as to give the same E.M.F. against copper as that given by the platinum, platinum-alloy couple. The resultant E.M.F. generated by this compound couple is the same as if the

[1] Abridged from a paper read before the Institution of Mechanical Engineers by Robert S. Whipple.

[2] Traité Pratique de la Thermométrie de Précision, C. E. Guillaume.

[3] *Philosophical Magazine*, March and April, 1893, C. Chree.

[4] As an instance when engineers have been keenly interested in temperature measurement to this degree of accuracy, mention must be made of the work of Prof. Barnes, on frazil ice. He has shown that differences in the water temperature of 0·001° C. may bring about the formation of frazil ice which may throw out of action a complete hydro-electric plant. In his case all the measurements were made with resistance thermometers. See "Ice Formation, chap. v., H. T. Barnes. (London: Chapman and Hall, Ltd.)

[5] *E.g.* the lens-front thermometer invented by Luigi Peroni.

[6] *Phil. Mag.*, xli., p. 465, 1896.

[7] British Patent Specification, No. 14514. A.D. 1904.

[8] *Ibid.*, No. 370, A.D. 1909.

entire couple were of platinum, platinum-alloy. For accurate work it cannot be assumed that variations in the temperature of the vicinity of the galvanometer are of no importance. Corrections must be applied to reduce the readings to the correct values at 0° C. In practice it will be found that the simplest way of maintaining the cold junction at a constant temperature is to use a Dewar vessel or thermos-flask filled with oil (see Fig. 1) into which the cold junction of the thermo-couple, or of the composite thermo-couple, is placed.

A simple form of potentiometer in conjunction with a direct moving-coil galvanometer, has largely increased the usefulness of the direct-reading instruments by opening out the scale to any desired extent. For the autographic recording of temperature the photographic arrangement originally due to Le Chatelier is still the only way of recording very small and

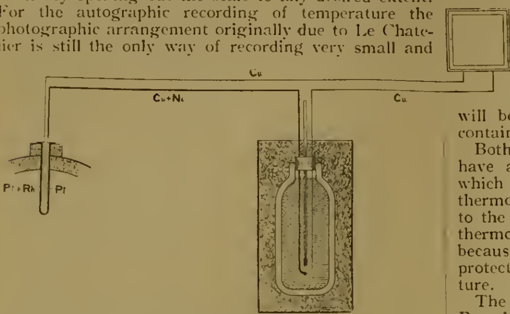

FIG. 1.—Thermos-flask cold-junction control.

rapid changes in temperature. In the majority of recorders now in general use the galvanometer pointer is depressed intermittently by clockwork, or some electrical mechanism on to either an inked thread or typewriter ribbon which is pressed on to a chart mounted on a rotating drum (clock-driven), the resulting record being a series of ink marks. The thread recorder (Fig. 2), designed by Mr. Horace Darwin, may be taken as a typical example of one of these recorders. The action of the clockwork in depressing the galvanometer boom on to the paper is so rapid that the boom is only under control by the chopper-bar for less than two seconds out of the minute. The figure illustrates a double recorder in which two galvanometers connected to two separate thermo-couples are recording on the same drum.

Resistance Thermometers.

Sir William Siemens was the first to suggest, in 1871, that the change in the electrical resistance of a wire with temperature might be employed as a means of measuring temperatures. In the hands of Callendar and Griffiths this has become the most accurate method of measuring temperatures up to 1200° C. Callendar pointed out that if R_0 denoted the resistance of the thermometer coil at 0° C. and R_1 its resistance at 100° C., a temperature scale could be established for that particular wire which might be called the scale of platinum temperatures, such that, if R were the resistance of the coil at any temperature t on the gas scale, the temperature on the platinum scale would be $R - R_0/R_1 - R_0 \times 100$. For this quantity he employs the symbol pt, its value depending on the sample of platinum chosen.

In order to reduce the temperatures on the platinum scale pt to the gas scale, it is necessary to know the law connecting t and pt. They are, of course, identical at 0° and 100° C., and experiment has shown that the formula:—

$$t - pt = \delta\left\{\left(\frac{t}{100}\right)^2 - \frac{t}{100}\right\}$$

when δ is a factor depending on the purity of the wire for making the thermometer, expresses the relationship between them in other parts of the scale.

The $t - pt$ curve being a parabola, it is only necessary to determine the resistance at three different temperatures in order to ascertain the value of δ, and thus to standardise the thermometer completely. The three temperatures usually employed are 0°, 100°, and 444·70° C. (the boiling point of sulphur).

The resistance of the thermometer is usually measured by the ordinary Wheatstone Bridge methods, and several instruments have been designed for this purpose.

The methods of measuring temperature to a very high degree of precision are outside the scope of this paper, but reference to them will be found in Dr. Burgess's book,[9] which also contains a full bibliography of papers on the subject.

Both thermo-electric and resistance thermometers have a distinct upper limit of temperature beyond which they should not be employed. The resistance thermometer cannot be used beyond 1200° C., owing to the disintegration of the mica frame, and even the thermo-couple can rarely be used above 1400° C., because of the impossibility of finding a gas-tight protecting envelope that will last above this temperature.

The porcelain tubes made by the Royal Berlin Porcelain Manufacturing Co. are on the whole the most satisfactory. This firm have comparatively recently introduced a tube made of a new material called "Marquardt," which will resist temperatures

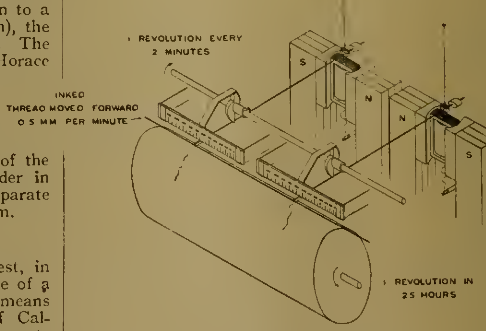

FIG. 2.—Diagram of double-thread recorder.

up to 1700° C. (approximately the melting point of platinum). Unfortunately tubes made of this material are very brittle, and great care must be taken in handling them, especially in allowing them to cool slowly. Tubes made of fused quartz are also employed, but it will be found that these tubes soon devitrify and become brittle if used continuously at a temperature of 900° to 1000° C.

9 "The Measurement of High Temperatures," pp. 212–218, 470–471. By G. K. Burgess and H. Le Chatelier. (London: Chapman and Hall, Ltd.) In this connection it may be mentioned that Principal E. H. Griffiths successfully made differential temperature measurements between the freezing points of two liquids to one-millionth of a degree Centigrade by means of resistance thermometers and a sensitive bridge.

Optical and Radiation Pyrometers.

The temperatures reached in many modern manufacturing processes are so high that the temperature can only be measured by optical or radiation methods. It was not, however, until Le Chatelier[10] invented his optical pyrometer in 1892 that any really satisfactory attempt was made to determine the temperature of a hot body by measuring the radiations emitted by it.

The intensity of the light emitted by a hot body

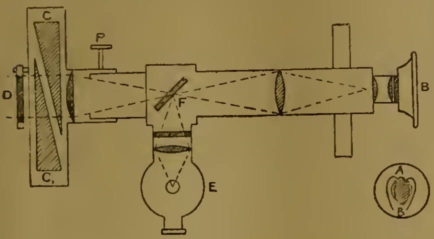

FIG. 3.—Diagram of Féry absorption pyrometer.

varies immensely with the temperature,[11] and therefore, at the first glance, one would assume that the easiest way to measure a temperature would be to compare photometrically the light emitted by the hot body with that emitted by a second hot body at a definite temperature. This would be the simplest way of doing so, if all bodies at the same temperature emitted the same amount of light, but unfortunately such is not the case, the light, for example, from incandescent iron and carbon is much greater than that of porcelain or platinum at the same temperature.

Kirchoff first propounded the idea of a "black-body" as being a body which would absorb all radiations falling upon it, and would neither reflect nor transmit any. He also showed that the radiation from such a black-body is a function of the temperature alone, and was identical with the radiation inside an enclosure, all parts of which are at the same temperature. All substances, if they are heated inside a black-body, will emit the same radiation, and if looked at through a small opening in the furnace will appear of uniform brightness. Stefan was the first to state that the energy radiated was proportional to the fourth power of the absolute temperature. Boltzmann later deduced the same law from thermodynamic reasoning. This law has since become known as the Stefan-Boltzmann radiation law, and may be stated as follows :—

The total energy radiated by a black-body is proportional to the fourth power of the absolute temperature, or $E=\sigma(T^4-T_0^4)$, where E is the total energy radiated by the body at absolute temperature T to the surroundings at absolute temperature T_0 and σ is a constant depending on the units used.[12]

This law has received ample experimental verification throughout the range over which temperature measurements can be made.

As previously mentioned, the first satisfactory radiation pyrometer was that designed by Le Chatelier.

The instrument is really a form of photometer, in that it is arranged to match the luminous radiation obtained from an incandescent body against that obtained from a standard lamp. This instrument in the form modified by Féry is illustrated in Fig. 3. It consists of a telescope DB, which carries a small comparison lamp E attached laterally. The image of the flame of this lamp is projected on to a mirror, F, placed at 45° to the axis of the telescope, the mirror being silvered only over a narrow vertical strip. The telescope is focussed on the object the temperature of which it is desired to measure, the object being viewed on either side of the silvered strip. A coloured glass in the eyepiece ensures monochromatic conditions. A pair of absorbing-glass wedges, C and C_1, are placed in front of the objective of the telescope, and these wedges are moved laterally by means of a screw until the light from the object under observation appears of equal brightness to that emitted by the standard lamp. A table provided with the instruments converts the readings obtained by the scale into degrees centigrade.

The Holborn-Kurlbaum pyrometer is shown diagrammatically in Fig. 4; it is a photometric in-

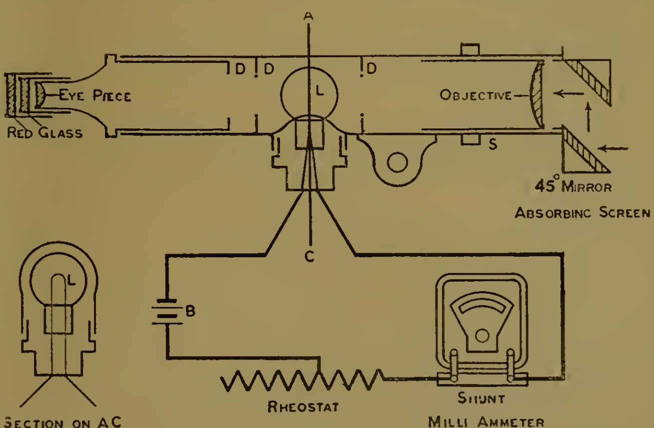

FIG. —The Holborn and Kurlbaum optical pyrometer.

strument of rather a different character. A small incandescent lamp L is mounted in the focal plane of the objective and eyepiece of a telescope. The lamp circuit is provided with a battery, rheostat, and sensitive ammeter. The

[10] "On the Measurement of High Temperatures," H. Le Chatelier (*Comptes rendus*, vol. cxiv., pp. 214-216, 1892).

[11] If the intensity of red light $\lambda=0\cdot656\mu$ emitted by a hot body at 1000° C. is called 1, at 2000° C. the intensity will be 2100 times as great (see C. W. Waidner and G. K. Burgess, "Optical Pyrometry," Bulletin No. 2 of the Bureau of Standards).

[12] The laws of radiation and the various forms of optical and radiation pyrometers are fully discussed in Dr. Burgess' book, *loc. cit.* Two other good *résumés* will be found—(1) "Optical Pyrometry," C. W. Waidner and G. K. Burgess (Bulletin No. 2 of the Bureau of Standards; and (2) "The Black Body and the Measurement of Extreme Temperatures," A. L. Day and C. E. van Ostrand (*Astrophysical Journal*, vol. xix., 1-40).

telescope is focussed on the incandescent body, thus bringing its image into the plane AC. The current is then adjusted by means of the rheostat until the filament is of the same colour and brightness as the object. A previous calibration of the current for the particular lamp used, in terms of temperature, will then give the temperature of the hot body.

Radiation pyrometers differ from the optical types previously discussed in that they employ all the radiation received from the hot body. The first practical form of pyrometer making use of total radiation was invented by Féry. The instruments is shown in section in Fig. 5. The radiation from the hot body is focussed by means of the concave mirror on to a sensitive thermo-couple mounted at D; the electromotive force generated by the couple is indicated on a galvanometer connected to the terminals, B, B In another form of the instrument Féry has replaced the thermo-couple by a bi-metallic spiral placed in the focus of the mirror. When heated the spiral uncoils and carries an aluminium pointer over a dial divided in degrees of temperature.

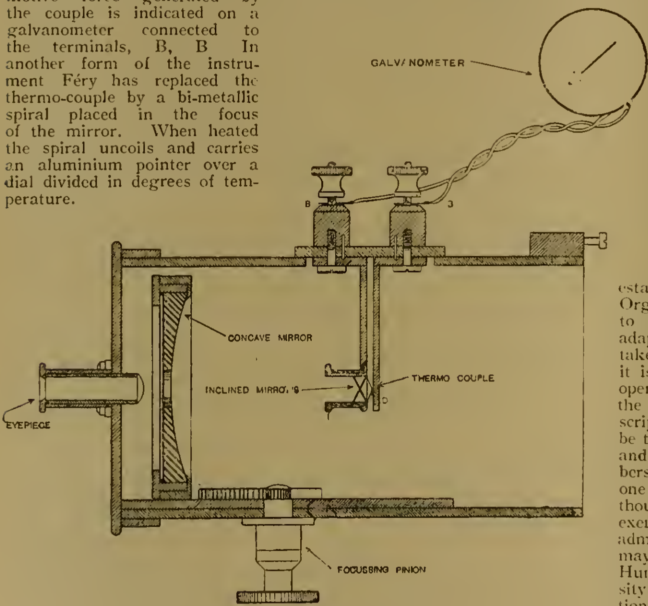

FIG. 5.—Diagram of Féry radiation pyrometer.

The author discussed briefly the capabilities and limitations of the optical and radiation pyrometers with the view of assisting observers in their use. He also threw out suggestions as to the best forms of pyrometer to be used in various industrial operations.

In discussing the question of the standardisation of pyrometers, the author pointed out that unless pressed for time the observer would find it advisable to send his instruments to the National Physical Laboratory, when they would be examined and their corrections determined for a moderate fee. In a works where there are a large number of instruments, it is advisable to keep a set of instruments which have been examined at the National Physical Laboratory as standards of reference. If this is not possible, corrections at one or two points in the range of the thermometer can generally be determined. The author mentioned the boiling points of some liquids and the freezing points of some pure metals and salts which would be found useful as standardisation points.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. H. F. Baker, F.R.S., fellow and lecturer of St. John's College, and Cayley university lecturer in mathematics, has been elected Lowndean professor of astronomy and geometry in succession to the late Sir Robert Ball.

DR. LIVINGSTON FARRAND, professor of anthropology at Columbia University since 1903, became president of the University of Colorado on New Year's Day. A native of Newark, New Jersey, he graduated at Princeton in 1888, and, after completing a medical course in America, studied for two years at Cambridge and Berlin, before receiving an appointment as instructor in psychology at Columbia in 1893.

IT is proposed to establish a club for graduates, teachers, and officers of the University of London. The proposal has been approved by the Senate of the University and by Convocation. Negotiations are in progress for the lease of 19 and 21 Gower Street, W.C., and, subject to a satisfactory assurance as to the number of members joining the club if established in these premises, the Organisation Committee is willing to continue negotiations. The adaptation of the premises will take some time to carry out, but it is hoped that the club may be open to members immediately after the Easter vacation. The subscriptions in the first instance will be two guineas for town members, and one guinea for country members. The entrance fee will be one guinea, except that the first thousand original members will be exempt. A form of application for admission to original membership may be obtained from Mr. T. Ll. Humberstone, secretary, University of London Club Organisation Committee, University of London, South Kensington, S.W.

SOCIETIES AND ACADEMIES.

LONDON.

Society of Chemical Industry, January 5.—Dr. W. R. E. Hodgkinson in the chair.—J. L. **Strevens**: The viscosity of oils. The author, after emphasising the importance of the determination of absolute viscosity and its relation to temperature for any particular lubricant, proceeds to correct certain figures previously published.—L. T. **Wright**: The oxygen content of the gases from roasting pyrites. The author on examining a number of analyses of "burner" gas from various sources noticed that the oxygen "deficiency" is the greater the greater the dilution of the gas, and this suggests that there is in addition to the well-known production of SO_3 and metallic sulphates some other cause, such as a constant error in the analyses, which influences these. In any case, the evidence of these gas analyses shows that the manner in which the oxygen is disposed of would prevent the "burner" gas containing more than about 12 per cent. of SO_2 as a maximum when all the oxygen of the air supplied was used up, and the author states that his various attempts to obtain more than this in practice by keeping burner gas long in contact with incandescent pyrites have failed.—L. C. **Jackson**, L. **McNab**, and A. C. H. **Rothera**: The electrical conductivity of milk during the concentration, with suggestions for a practical method of determining the end point in the manufacture of sweetened condensed milk. Although the measurement of electrical conductivity is of no value in determining the degree of concentration of a separated unsweetened milk, it can be made the basis of a working process for watching the concentration of sweetened whole milk. A device in which the resistance of sweetened milk in the vacuum pan is compared with that of an approved sample of condensed milk maintained at exactly the same temperature is described.—S. J. **Johnstone**: Monazite from some new localities. Wide variation may occur in the quantity of thoria present in samples; notable amongst these are ranges shown by those from Ceylon, the thoria percentage of which varies from 9·5 to 28·2; from Malaya, 3·4 to 9·4; and from northern Nigeria, 2·3 to 8·0.

PARIS.

Academy of Sciences, January 5.—M. P. Appell in the chair.—L. **Lecornu**: A project of "Monument de l'heure." Suggestions for the erection of a monument at Villers-sur-Mer on the meridian of Greenwich.—R. de **Forcrand**: Ferrous sulphate and its hydrates. Methods are given for preparing the hepta-, tetra-, and mono-hydrates of ferrous sulphate in a pure state. The pure anhydrous salt could not be prepared, some basic sulphate being always present. The heats of solution of these four salts are given.—M. **Coggia**: Observations of the comet 1913*f* (Delavan) made at the Observatory of Marseilles with the comet-finder. Positions are given for December 21 and 22.—Ch. **Platrier**: A characteristic property of surfaces of constant negative total curvature.—E. **Goursat**: Certain extensions of Stokes's formula.—Emile **Borel**: Some problems of geometrical probabilities and hypotheses of discontinuity.—Pierre **Weiss**: The molecular field and the magnetising action of Maurain. Maurain has studied experimentally the magnetic properties of iron deposited electrolytically in a magnetic field; it is shown that the law of variation with distance (inversely as the sixth power) previously deduced by the author holds in this case.—Marcel **Boll** and Victor **Henri**: The non-influence of oxygen on certain photochemical reactions. Two reactions were studied, the decomposition of tetrachloroplatinic acid, and of oxalic acid in presence of uranyl nitrate, and the reaction velocities in absence and presence of air compared. It is shown that Bodenstein's theory is inapplicable to these two photochemical reactions.—L. **Gay**: The relations between the covolume *b* and the critical constants. The critical constants of substances not strongly polymerised can be determined with fair accuracy from the constancy of the ratios V_c/b and $R\theta/\pi b$.—Paul **Pascal**: The magnetic properties of the alkali metals in their compounds.—Manuel **Veres**: Researches on cadmium. Description of the preparation and properties of the double sulphate, $2CdSO_4.(NH_4)_2SO_4$.—A. **Bouzat** and Ed. **Chauvenet**: The heat of formation of some compounds of cupric chloride with ammonium chloride.—H. **Taffanel**: The combination of gaseous mixtures and reaction velocities.—A. **Sartory**, J. **Gratiot**, and F. **Thiébaut**: The rejuvenation of the potato. Experiments on raising potatoes from seed. The plants raised were vigorous and free from disease.—Marcel **Dubard**: General remarks on the place and characters of classification of the Mimusopeæ.—J. **Magrou**: Symbiosis and tuber formation in the potato. It has been found by experiment that with the potato growing on poor soils, comparable with soil in which the wild potato is found, symbiosis exercises a decisive influence on the formation of the tubers. These results are in agreement with views of Noël Bernard on symbiosis and evolution.—Etienne **Rabaud**: The experimental study of an instinct. A study of the conditions governing the migration of *Myeloïs cribrella* in its larval state, from the head to the stem of the plant serving as its host.—M. **Lécaillon**: Rudimentary parthenogenesis in the golden pheasant (*Phasianus pictus*).—Max **Kollmann** and Louis **Papin**: The chondriome of the Malpighi body of the œsophagus; the signification of Herxheimer's filaments.—P. **Masson**: The endocrinal gland of the intestine in man.—H. **Bierry** and Mlle. Lucie **Fandard**: The sugar of the blood plasma.—Ch. **Dhéré**: The photographic determination of the fluorescence spectra of the chlorophyll pigments.—Charles **Lepierre**: Zinc and Aspergillus. The experiments of M. Coupin and M. Javillier.—Em. **Bourquelot** and A. **Aubry**: The influence of the alcoholic strength on the biochemical synthesis of α-ethylglucoside and α-propylglucoside.—F. **Garrigou**: The utilisation of phreatic sheets by towns built on alluvial terraces of valleys.—Emile **Haug**: The zone of the Jurassic hills of Nans.—Alfred **Angot**: Value of the magnetic elements at the Val-Joyeux on January 1, 1914.

BOOKS RECEIVED.

Das Kaiser-Wilhelm-Institut für Chemie, Berlin-Dahlem. By E. Fischer and E. Beckmann. Pp. 68. (Braunschweig: F. Vieweg und Sohn.)

Das Tierreich. 40 Lief. Tunicata. Salpae ii. Cyclomyaria et Pyrosomida. By Dr. G. Neumann. Pp. ix+36. (Berlin: R. Friedländer und Sohn.)

Einführung in die Erdbeben- und Vulkankunde Süditaliens. By A. Sieberg. Pp. vi+226+plates. (Jena: G. Fischer.) 4 marks.

Cours de Physique Générale. By H. Ollivier. Tome Premier. Pp. 716. (Paris: A. Hermann et Fils.) 18 francs.

Le Système du Monde. By Prof. P. Duhem. Tome Premier. Pp. 512. (Paris: A. Hermann et Fils.) 18.50 francs.

Uganda Protectorate. Annual Report of the Department of Agriculture for the Year ended March 31, 1913. Pp. 41. (Kampala: The Uganda Co. Press.)

Egyptian Government Almanac for the Year 1914. Pp. vii+216. (Cairo: Government Press.) P.T.5.

The Manuring of Market Garden Crops. By Dr. B. Dyer and F. W. E. Shrivell. New edition. Pp. 149+plates. (London: Vinton and Co., Ltd.) 1*s*.

Astronomy. By E. Hawks. Pp. 120+iii plates. (Manchester: Milner and Co.) 1*s*. net.

Lessons in Elementary Tropical Hygiene. By H. Strachan. Pp. xi+116+vi plates. (London: Constable and Co., Ltd.) 1*s*. net.

The Influence of the Gold Supply on Prices and Profits. By Sir D. Barbour. Pp. xii+104. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

The Biology of the Blood-cells, with a Glossary of Hæmatological Terms. By Dr. O. C. Gruner. Pp. xii+392+plates. (Bristol: J. Wright and Sons, Ltd.) 21*s*. net.

The Nature of Enzyme Action. By Prof. W. M. Bayliss. Third edition. Pp. viii+180. (London: Longmans and Co.) 5*s*. net.

The Chemistry of Cattle Feeding and Dairying. By J. A. Murray. Pp. xii+343. (London: Longmans and Co.) 6*s*. net.

Willing's Press Guide for 1914. Pp. xii+474. (London: J. Willing, Ltd.) 1s.

The Cultivation of the Oil Palm. By F. M. Milligan. Pp. xiv+100+plates (London: Crosby Lockwood and Son.) 2s. 6d. net.

Behaviour Monographs. Audition and Habit Formation in the Dog. By H. M. Johnson. Pp. iv+78. (Cambridge, Mass.; New York: H. Holt and Co.)

Studien zur Pathologie der Entwicklung. Edited by Dr. R. Meyer and Dr. E. Schwalbe. I. Band. Heft 2. (Jena: G. Fischer.) 10 marks.

Memoirs of the Geological Survey of India. Vol. xxxix. Part 2. Geology of the Northern Shan States. By T. H. D. La Touche. Pp. iv+379+xli+27 plates. Vol. xl. Part 1. The Oil Fields of Burma. By E. H. Pascoe. Pp. x+269+xxxix+54 plates. (Calcutta: Geological Survey of India; London: Kegan Paul and Co., Ltd.) 4s. and 6s. 8d.

The Art of Dying. In two parts. Pp. 356. (Stratford-on-Avon: The Tapestry Studio.) 3s. 6d.

Waves of Sand and Snow and the Eddies which Make Them. By Dr. Vaughan Cornish. Pp. 383. (London: T. Fisher Unwin.) 10s. net.

Studies in Water Supply. By Dr. A. C. Houston. Pp. xii+203. (London: Macmillan and Co., Ltd.) 5s. net.

A Junior Geography of the World. By B. C. Wallis. Pp. ix+310. (London: Macmillan and Co., Ltd.) 2s. 6d.

National Defence v. Channel Tunnel. By Admiral Sir A. de Horsey. Pp. 15. (London: Longmans and Co.) 3d. net.

Lehrbuch der Meteorologie. By Dr. J. Hann. Dritte Auflage. Lief 2 und 3. (Leipzig: C. H. Tauchnitz.)

The Curious Lore of Precious Stones. By Dr. G. F. Kunz. Pp. xiv+406+plates. (Philadelphia and London: J. B. Lippincott Co.) 21s. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 15.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Some Scientific Results of Captain Scott's Antarctic Expedition: G. Taylor.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Museums: A Centenary Retrospect: Col. T. H. Hendley, C.I.E.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Bereozovsk Gold Deposit, Ural District, Russia: C. W. Purington.—The Outlook for the Mineral Industry in Canada: J. M. Bell.

LINNEAN SOCIETY, at 8.—Lantern Slides Illustrating the Fauna and Flora of the Interior of Vancouver, from her last journey: Mrs. Henshaw.—Some Observations on the Tentacles of *Blennius gattorugine*: H. A. Baylis.—(1) Some Recent Additions to the British Flora; (2) A Note on Article 45 of the Vienna Code; (3) The Abridgment of Miller's "Gardener's Dictionary" of 1754, and Hill's "British Herbal" of 1756: G. C. Druce.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Discussion on Mr. C. J. Waldram's Paper: Some Problems in Daylight Illumination, with Special Reference to School Planning."

MATHEMATICAL SOCIETY, at 5.30.—(1) A Generalisation of the Euler-Maclaurin Sum Formula; (2) The Deduction of Formulæ of Mechanical Quadrature from the Generalised Euler-Maclaurin Sum Formula: S. T. Shovelton.—Binary Forms: A. Young.

FRIDAY, JANUARY 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Commercial Tests of Internal Combustion Engines: W. A. Tookey.

MONDAY, JANUARY 19.

VICTORIA INSTITUTE, at 4.30.—Japan, and some of its Problems, Religious and Social: Rev. Prebendary H. E. Fox.

ROYAL SOCIETY OF ARTS, at 8.—The Relation of Industry to Art: Sir Charles Waldstein.

TUESDAY, JANUARY 20.

ROYAL STATISTICAL SOCIETY, at 5.—The Fertility of Marriage in Scotland: A Census Study: Dr. J. C. Dunlop.

INSTITUTION OF CIVIL ENGINEERS at 8.—*Further Discussion*: Superheating Steam in Locomotives: H. Fowler.

WEDNESDAY, JANUARY 21.

ROYAL SOCIETY OF ARTS, at 8.—The Modern Poster, its Essentials and Significance: W. S. Rogers.

AËRONAUTICAL SOCIETY, at 8.30.—The Stability of Aëroplanes: L. Bairstow.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual General Meeting.—Address on Upper Air Research: C. J. P. Cave.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address: The Microscope and Medicine: Prof. G. Sims Woodhead.

GEOLOGICAL SOCIETY, at 8.—Geology of the Country round Huntly (Aberdeenshire): W. R. Watt.—The Glaciation of East Lancashire: Dr. A. Jowett.

THURSDAY, JANUARY 22.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—On the Heat Production Associated with Muscular Work. (A Note on Prof. Macdonald's Paper. Proc. R.S., B, vol lxxxvii.): Dr. R. T. Glazebrook and D. W. Dye.—The Chemical Interpretation of some Mendelian Factors for Flower Colour: M. Wheldale and H. L. Bassett.—The Determination of the Minimum Lethal Dose of various Toxic Substances and its Relationship to the Body Weight in Warm-blooded Animals, together with considerations bearing on the Dosage of Drugs: Prof. G. Dreyer and Dr. E. W. A. Walker.—Experiments on the Restoration of Paralysed Muscles by means of Nerve Anastomosis. Part ii., Anastomosis of the Nerves supplying Limb Muscles: Prof. R. Kennedy.—Variations in the Sex Ratio of *Mus rattus* following an Unusual Mortality of Adult Females, based on an Analysis of Weight Frequency Distributions: Dr. F. N. White.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Fifth Kelvin Lecture: Sir Oliver Lodge.

FRIDAY, JANUARY 23.

PHYSICAL SOCIETY, at 5.—Some Characteristic Curves and Sensitiveness Tests of Crystals and other Detectors: P. R. Coursey.—Exhibition of a Water Model of the Musical Arc: W. Duddell.—Further Experiments with Liquid Drops and Globules: C. R. Darling.—A Note on Aberration in a Dispersive Medium and Airy's Experiment: J. Walker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Testing of Materials for Use in Engineering Construction: F. W. Monkhouse.

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*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

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THURSDAY, JANUARY 22, 1914.

MATHEMATICIANS IN COUNCIL.

Proceedings of the Fifth International Congress of Mathematicians. (Cambridge, August 22–28, 1912.) Edited by Prof. E. W. Hobson and Prof. A. E. H. Love. Vol. i., Part i., Report of the Congress. Part ii., Lectures: Communications (Section I.) Pp. 500. Vol. ii., Communications to Sections II–IV. Pp. 657. (Cambridge University Press, 1913.) Price 30*s.* net, two vols.)

A REVIEW of these beautifully printed publications of the Cambridge Press necessarily constitutes in some measure a survey of the proceedings of the Fifth International Congress of Mathematicians. Although more than a year has elapsed since these meetings were held at Cambridge, it may not yet be too late to form an opinion on the work that was then done, and its influences on the progress of mathematical science, and on the position of mathematics in Great Britain. These are subjects on which no two people can be expected to hold the same opinions, and it is therefore of great importance that a reviewer should be able to state his own views without prejudice to those held by other members present at the Congress, readers of the proceedings, or, indeed, anyone else.

While the corresponding records for Heidelberg (1904) are contained in one volume of 756 pages, and for Rome (1908) in three volumes, of which the first two contain 218 and 318 pages, the Cambridge volumes occupy 500 and 657 pages respectively. Nor was the attendance at the meeting less satisfactory. While Great Britain only contributed 2 per cent. of the members at Heidelberg and 4 per cent. at Rome, the attendance of 221 British members out of a total of 574 at Cambridge compares favourably with Germany's representation of 173 out of 336 at Heidelberg, and Italy's 190 out of 535 at Rome.

Turning next to the published papers, these reflect in no small degree the influences that have been making themselves felt in recent years in raising higher mathematics to the dignity of a science, and saving it from degenerating into mere cut-and-dried algebra. Even in that most difficult of all to popularise section—arithmetic, algebra, and analysis—the papers deal largely with analysis, and are not overloaded with formulæ, while a pleasing variety is introduced by descriptions of mechanisms for solving equations, and cases where a sum of powers is equal to the same power of one number. A physicist who was exclusively a physicist might find much to interest him in some of these papers. On the other hand, in the geometry section, where one naturally expects to find results adapted to visualisation, there are very few papers in which the investigations are not expressed in symbolic form. The paper on rational right-angled triangles would have been better placed alongside of the one above referred to on sums of powers. Is it the fact that pure geometry is exhausting its resources in three dimensional space, and that it is becoming increasingly difficult to find new subjects of investigation which do not require the use of extended algebraic formulæ?

Coming now to applied mathematics, the most noticeable feature is that the papers presented contain no conspicuous reference to aëroplanes, and, indeed, judging from their general character, it seems almost, if not quite, certain that the aëroplane has nowhere received mention in the proceedings of this section. We have work submitted on the old hackneyed "problem of three bodies," performing motions which no living man will ever see realised experimentally, also theories of the æther and gravitation. Now the peculiar type of brain which is capable of investigating the hypothetical motions of three hypothetical bodies is just the intellect required to investigate the motions of the most general character described by an aëroplane, and if it is necessary to assume a simplified law of air resistance, the conclusions will certainly afford some definite basis for a comparison of theory with experiment. As for the æther, this might well stand over when we know so little about the air, and with regard to gravitation, the fact that it may be propagated with finite velocity through space can scarcely give an aviator any hope of saving his life in the event of his aëroplane collapsing. The aviation problems awaiting solution at the time that this congress was held—and after—would have amply sufficed to occupy the proceedings of a separate section.

Possibly an appeal to Prof. Reissner might have elicited some contribution on this subject. With regard to workers in our own country, it seems not improbable either that Lord Kelvin died too soon, or that aëroplanes came too late. Lord Kelvin had an extraordinary power of commanding both the attention and respect of the practical engineer and the interest of the mathematician, and had he been able to investigate the stability of aëroplanes, it is certain that the present deadlock would never have arisen; on the contrary, mathematical proceedings would have been filled with aëroplane papers, and aviators would be presented with results of far deeper reasoning than is contained in the writings of some authors who have dealt with the subject. The balancing of the four-crank engine and a paper on the graphical recording of sound waves accompanied by diagrams which seem instinctively to represent graphically the strident tones of the gramophone, have at least some relation to the vast complex of unsolved problems which present themselves in everyday life.

In view of the ever-growing importance of statistical science it is gratifying to find the subsection dealing with this subject represented by eleven papers, nearly half of them by British contributors. The next section deals with philosophy, history, and teaching of mathematics. There are ten papers and discussions on "didactics," but the most important feature of this section is the report of the International Commission on Mathematical Teaching, which was constituted at Rome with Prof. Fehr, Sir George Greenhill, and Prof. Klein as executive committee. The list of publications drawn up by them and by the various subcommittees for different nations occupies twelve pages of the volume. The publication of these reports has received substantial financial aid from the Governments of the respective countries, and they deal fairly thoroughly with the conditions of mathematical teaching in all grades of schools and in the universities. The main danger is that few people will have the time to read the reports for any except their own nation.

In addition to the sectional meetings of the congress, we have eight lectures by Profs. Bôcher, Borel, Brown, Enriques, Prince Galitzin, Prof. Landau, Sir J. Larmor, and the late Sir W. H. White.

Profs. Hobson and Love are to be greatly congratulated on their success in organising the congress and bringing out this splendid record of some of the advances of mathematical science in the four years preceding the meeting.

In the opinion of the present reviewer, however, one important element of success was missing. The holding of a mathematical congress in Great Britain afforded a unique opportunity for bringing the claims of British mathematicians before the British public. A discussion on this subject could easily have been organised on purely international lines, and representatives of different nations would have been able to give us their own experiences as to the extent that their efforts are recognised and backed up by public support in their countries. The proceedings of such a discussion would have been widely circulated in Press reports, and would have appealed to, and been read with interest by numbers of, people to whom papers of an abstract character are unintelligible and uninteresting. Had the congress been a classical one, there is little doubt that discussions on the educational value of Latin would have been widely reported in all the newspapers, and often accompanied by long leading articles.

But no such discussion was held. On the contrary, the address by the late Sir William White on "The Place of Mathematics in Engineering Practice"—the one address sufficiently popular for the ordinary newspaper reporter and reader—was certainly not calculated to remove existing prejudices against the "unpractical" mathematician. But if the position of English mathematics and mathematicians did not figure in the official programme, it was freely discussed in the reception room, the refreshment tent, and the college halls where guests were hospitably entertained. References were not infrequent to cases of hardship where able mathematicians had failed to earn adequate incomes from teaching work, and to fallings-off in the numbers attending mathematical classes both in Cambridge and elsewhere. This private interchange of experiences between the initiated could scarcely serve any useful purpose; while a vigorous appeal to the public in plain English language, supported by a sufficient body of English speakers, and aided by the opinions of foreign experts, might have exercised a marked influence over the progress of future events.

In short, the Cambridge Mathematical Congress has done nothing towards improving the prospects of the brilliant mathematician who is too good to spend his life in badly paid teaching appointments even when he can secure them.

It has done nothing to stop the exodus from our university classes of the best mathematical talent that is sent up from the schools, and which is attracted by the better prospects that are open to students of chemistry or engineering.

It has done nothing towards increasing the staffs of our university colleges, and providing them with an adequate number of mathematical professors, each a specialist in his own line; while on the other hand the diversion of students into other channels frequently renders such increases financially impossible.

It has thus done nothing towards helping our English university colleges to come into line with those of other countries as centres of higher study and mathematical research.

And such an opportunity is not likely to recur for many a year to come. G. H. BRYAN.

THE CASE AGAINST RELATIVITY.

Die Physik der bewegten Materie und die Relativitätstheorie. By Dr. Max B. Weinstein. Pp. xii + 424. (Leipzig: J. A. Barth, 1913.) Price 17 marks.

FEW general theories have suffered more at the hands of their own exponents than the principle of relativity. The call to reconsider our preconceptions as to the measurement of space and time, sounded by Einstein in 1905, was the signal for many self-confident minds to reconsider everything, and a flood of literature appeared in which it was difficult to find any real sense of physical reality.

It was given to Minkowski to express the fundamental idea of the principle in a form which, while severely mathematical and repulsive to many physicists' minds, was concise and elegant, and furnished a powerful method of examining the consequences of the general hypothesis. It enabled him, for example, to modify the electromagnetic equations for moving bodies as adopted by Lorentz in such a way as to conform exactly to the hypothesis of relativity, while agreeing with them to the degree of approximation to which they were experimentally verifiable.

But beyond this Minkowski's method opened the way for a rediscussion of the foundations of dynamical theory, and here its anticipations are beyond the reach of experiment, and in this region particularly have many writers lost touch with reality.

In the work before us Dr. Weinstein tries to check this enthusiasm, and to compare critically the outcome of Minkowski's theory, which may be looked upon as a descendant of the electrodynamics of Lorentz, with the earlier work of Maxwell and Hertz, and with what experimental evidence is available.

His main conclusion is that the experimental basis of the principle of relativity is so meagre as scarcely to justify its adoption and application, although his admiration for the work of Minkowski is so great that he dedicates the volume to his memory. Further than this, Dr. Weinstein is not entirely prepared to admit the theory of Lorentz as a necessary correction to the Maxwell-Hertz theory, being dissatisfied with the conclusiveness of the experiments of Wilson and Eichenwald in favour of the former, and while deprecating the multiplication of theories, he suggests yet another modification of the Hertz theory to explain the supposed discrepancy between it and the facts of aberration and of the Fizeau experiment.

Some of the criticisms raised, however, are singularly unconvincing. The validity of the Michelson-Morley experiment is questioned on the ground that the origin of the interference figure which was actually observed is not explained, although no doubt is thrown on the fact that the figure did not change when the apparatus was rotated. The case made out against Einstein's addition equation which is fundamental to the whole theory of relativity seems to the present writer to be lacking in logical accuracy, and tends to strengthen the impression that the author set out on the task of writing this large volume with a mind not entirely free from prejudice against what he terms "an impatience which almost bars the progress of science."

But one is tempted to ask whether to cling tenaciously to the conception of the æther formulated by Hertz, or even to the immovable æther of Lorentz, is not to place at least as great a barrier in the forward path as to search out with enthusiasm the consequences of an idea which is at least to an equal degree supported by, and the outcome of, experiment, and must in any case leave an enduring impression on our views as to the nature of physical magnitudes, in particular of space and time, as primary elements of thought.

REFLEX ACTION.

(1) *Irritability: A Physiological Analysis of the General Effect of Stimuli in Living Substance.* By Prof. Max Verworn. Pp. xii + 264. (London: Oxford University Press; New Haven: Yale University Press, 1913.) Price 15*s*. net.

(2) *Studies on the Influence of Thermal Environment on the Circulation and the Body-Heat.* By E. R. Lyth. Pp. vi + 72. (London: John Bale, Sons and Danielsson, Ltd., 1913.) Price 2*s*. 6*d*. net.

(1) THIS book is the outcome of the series of lectures given by Prof. Verworn under the Silliman Foundation of the University of Yale in 1911. Prof. Verworn has summarised the results of the investigations carried out by his co-workers and himself during the past twenty years, and in his preface he claims that he here presents "a uniform exposition of the general effects and laws of stimulation in the living substance." The book is certainly wide in scope, and is divided into nine chapters. The first of these is very interesting, as it deals with the historical aspects of the question, full credit being given to Francis Glisson as the founder of the doctrine of irritability. The subsequent lectures deal with the quality of the stimulus; the effects of stimulation, in which Prof. Verworn's well-known views on the so-called metabolic equi-

librium are discussed in full; the processes and the nature of the conduction of excitation; the conception of specific irritability, and the refractory period and its relation to fatigue; the interference of excitations, and finally the processes of depression.

In spite of the inherent interest of the subject, and although some of the discussions are very interesting, the book as a whole is somewhat disappointing. The disappointment is due partly to the fact that there is really but little new material, the matter having been for the most part previously published at length in readily accessible journals, and partly to the fact that a number of the conclusions reached are simply deductions drawn from pure hypotheses. Further, although Prof. Verworn in his preface states that he utilises the results obtained by other observers, the truth is that but little attention or criticism is devoted to the work of other investigators, and he makes but little reply to the criticisms which have been levelled at his own work.

The translation has been very well carried out by Frau Prof. Verworn, with the assistance of Dr. Lodholz, of the University of Pennsylvania. Unfortunately no index has been provided, although as a kind of compensation the contents of each chapter have been given in some detail.

(2) This small book contains rather a curious and, in its way, interesting collection of observations (the author states that he has made more than 25,000) on the pulse rate, the blood pressure, and the superficial (skin) and deep (rectal) temperatures of the body under various conditions of heat and cold. It is to be regretted that the author confines himself solely to his own observations, which seem to have been carried out largely upon himself, and does not refer at all to the fairly abundant available literature on the subject. Although the conditions of his experiments are not ideal, some of his data on the pulse rate are exceedingly interesting. The book is well illustrated with charts.

OUR BOOKSHELF.

The Use of Vegetation for Reclaiming Tidal Lands. By Gerald O. Case. (Reprinted from *Engineering*, August 22 and September 12, 1913.) Pp. 36. (London: St. Bride's Press, Ltd., 1913.) Price 2*s*. net.

The author has done good service by bringing together in this handy booklet the scattered information contained in various books and papers dealing with the part played by vegetation in the reclamation of tidal lands. A large part of this is drawn from the remarkable observations made by Prof. F. W. Oliver during his long-continued work on the physiography and plant ecology of maritime regions, especially at Erquy, in Brittany, and at Blakeney Point, in Norfolk, with reference to the stabilisation of drifting sand and shingle by means of vegetation. As these and other observations summarised in this booklet clearly show, there are large areas of foreshore in this country which might profitably be planted with suitable vegetation and subsequently reclaimed from the sea. The author has taken pains to avoid excessive use of botanical terms used in ecology, but it is to be feared that some of the terms he does use will prove somewhat puzzling to non-botanical readers, especially as some of them are used rather carelessly—"halophyte" and "halophytic," for instance, appear disguised as "hallophyte" and "hallophitic." F. C.

The A.B.C. Guide to Astronomy. (Third edition.) By Mrs. H. Periam Hawkins. Pp. 124. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.) Price 1*s*. 6*d*. net.

In this little book Mrs. Hawkins brings together a very useful amount of information which is admirably suited to be serviceable as a general source of reference to those not well acquainted with astronomical terms. The information is arranged alphabetically, and under each heading is a brief explanation or description. The catchwords are printed in heavy type, so that they are at once conspicuous when turning over the leaves. The text has been brought well up to date, and an appendix gives, among other information, a list of useful astronomical books.

The Purpose of Education. An Examination of the Education Problem in the Light of recent psychological Research. By St. G. L. Fox Pitt. Pp. ix+83. (Cambridge University Press, 1913.) Price 2*s*. 6*d*. net.

The sub-title of this small volume sufficiently describes its purpose. Experimental psychology is extending year by year our knowledge of the working of the human mind, and the attempt is made here to apply the results of recent psychological research to the solution of educational difficulties. The book may be commended to ordinary readers interested in education but unacquainted with psychology.

Experience Teaches. Some Advice to Youths, and incidentally to Young Women, as to their Careers in Life, with Notes on various social and commercial Problems. By Ivon Trinda. Pp. xi+194. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1914.) Price 4*s*. net in leather, 2*s*. 6*d*. net in cloth.

It may be doubted if many young people read books of advice as to conduct, and probably this chatty volume will prove of most assistance to parents and teachers whose duty it often is to offer words of warning. The advice is given here under the headings: school and what to learn, business, married life, recreation, and things in general.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Present-day Occurrence of Spontaneous Generation.

As is well known, Dr. Charlton Bastian has for several decades been investigating the occurrence of spontaneous generation—the development of living organisms from non-living matter. However opposed to what seems to be our common experience this may be, its occurrence at some time or other is at least suggested by modern doctrines of evolution. Dr. Bastian makes use of solutions containing colloidal matter, from which, if it has done so, living matter may be presumed most probably to have sprung. Although such solutions apparently contain no carbon and other constituent elements of protoplasm, an ample sufficiency of such elements to supply all requirements is present as "impurities" in the solutions.

I have carried out some experiments similar to those of Dr. Bastian, and although I have not yet been able in my laboratory to confirm Dr. Bastian's observations, I have obtained no evidence to prove that his are erroneous. I have on several occasions prepared the solutions, sealed them up in tubes, and submitted these to a *single* boiling. Before sterilisation, subcultures from the solutions have yielded abundant growths of micro-organisms, but after the single boiling I have never obtained growths on subculturing. This suggests that the *three* boilings to which the tubes are commonly subjected does kill all organisms present in them. I have, moreover, never once obtained the common forms of sporing bacilli from the sterilised tubes; had sterilisation been incomplete, these organisms would certainly have been expected.

The structures resembling organisms seen on many occasions in Dr. Bastian's tubes are, I am convinced, really organisms, and are not artefacts, pseudo-organisms, &c.; whether they be living or no cannot, of course, be determined microscopically, unless they be motile, which has been the case on two or three occasions (bacteria). Dr. Bastian has drawn up the following statement in order that his latest results may be brought before the scientific world.

R. T. HEWLETT.

Experimental Data in Evidence of the Present-day Occurrence of Spontaneous Generation.

IN the autumn of 1905 I found that microbes would grow and slowly multiply when inoculated into a weak solution of neutral ammonic tartrate in distilled water, and that though the organisms would grow in this solution without the aid of light, that light distinctly favoured the process, since when an inoculated solution was equally divided, the half which was left exposed to ordinary diffuse daylight became turbid much more quickly than the other half which had been placed within a dark incubator, even though the temperature of this latter was as much as 20° F. higher than that of the portion exposed to daylight.[1]

This was an experience in opposition with previous bacteriological doctrine, and it has been found to be of much importance in connection with experiments which I soon after commenced, and have ever since been continuing, bearing upon the question of the origin of life.[2]

Nature of the Experimental Solutions.

My first experiments were made with ordinary commercial sodium silicate (water-glass) diluted with an equal quantity of distilled water: a few drops of this fluid, varying from 1–8, being added to an ounce of distilled water containing six drops of dilute phosphoric acid and six grains of ammonium phosphate, or else to an ounce of distilled water containing simply eight drops of liq. ferri pernitratis of the British Pharmacopœia.

These solutions at first, and up to the summer of 1910, were the two experimental fluids always made use of, varying only in the number of drops of the dilute sodium silicate employed, in accordance with varying strengths of different samples of this product.

These solutions of water-glass have been found to deteriorate and undergo some slow changes (a rather copious white deposit gradually forms in the bottle in which they are kept), and after about eighteen months my solutions would no longer yield the same kind of experimental results as at first. Moreover, during the last twelve months I have been unable to obtain any satisfactory sample of water-glass.[3]

Strangely enough, Kahlbaum's 10 per cent. solution of sodium silicate, which is a comparatively uniform product, has never yielded any satisfactory results when it has been used in the preparation of my solutions.

On mentioning these troubles in the summer of 1910 to Dr. Otto Rosenheim, of King's College, he kindly gave me some of a very dilute solution of colloidal silica, prepared with great care after Graham's method, and made with the aid of the 10 per cent. solution of sodium silicate above referred to, the use of which had hitherto always proved unproductive.

This solution of colloidal silica gave more uniformly good results than I had ever obtained before, when I used ten to twelve drops of it to the ounce with the usual quantities of dilute phosphoric acid and of ammonic phosphate—though I have never been able to obtain a single successful result when using it with pernitrate of iron in the preparation of the yellow solution. Unfortunately, however, the weak solution of silicic acid, like the common water-glass solution, has seemed gradually to deteriorate, and that, too, much more rapidly, though in appearance the solution shows no change. Up to the present I have never been able to repeat successful results with a second solution when it was more than four months old.

Thus, it seems clear that the specimens of water-glass with which I first experimented successfully must have contained other favouring ingredients not present in the 10 per cent. solution of sodium silicate; further, that though this solution yielded only barren results, yet the colloidal silica prepared from it and from strong hydrochloric acid yielded the best results of all when used as an ingredient of one of the colourless solutions, but uniformly poor results when mixed with iron for a yellow solution.

From the point of view of the capability or the reverse of the different fluids for engendering living

[1] See *Knowledge*, August, 1905, p. 199.

[2] See "The Evolution of Life," 1907; and "The Origin of Life," 2nd edition, 1913 (Watts and Co.)

[3] Details on this subject will be found in "The Origin of Life," 2nd edit., pp. 86–91. Recently, however, Messrs. Allen and Hanbury have put me in communication with the London agents of their makers of water-glass, who have kindly supplied me with some samples of different specific gravity. An examination of them leads me to believe that the recent failures have been due to my having been supplied with samples of higher alkalinity than formerly. I have made new trials with a sample of 75° sp. gr., after diluting it with an equal bulk of distilled water and its behaviour with the other reagents (in their usual proportions) seems to be similar to that of the samples which I obtained in 1910, so long as *four* or *five drops* to the ounce are used for the yellow solution, and *three drops* to the ounce for the colourless solution. Samples of this diluted solution may be obtained from Messrs. Allen and Hanbury, of 6 Vere Street, W.

matter (owing to differences in chemical composition) these seeming contradictions may have no real significance; though the opposite point of view that my positive results may be due to the pre-existence of organisms in these particular solutions and not in the others which yielded negative results is a position that would seem quite impossible of reconcilement with the variations in composition above cited—even if the process of sterilisation had not intervened.

Sterilisation and After-Treatment of the Experimental Vessels.

The experimental tubes were prepared in this manner. A little more than half an ounce of either of the solutions was put into each of a number of sterilised glass tubes. These were then hermetically sealed, and subsequently heated for five to twenty minutes to temperatures ranging from 125° to 145° C., or else to 100° C. for twenty minutes on three successive days.

As in all previous experiments concerning the possibility of spontaneous generation by Pasteur, Pouchet, Tyndall, and many others, the destructive influence of heat was relied upon for ridding the fluids and vessels of any pre-existing living things that might be contained therein—these being very much less numerous in my saline solutions than in hay infusions and other organic media of which it was the custom formerly to make use.

Saline solutions were used by me because they could be submitted, within limits, to higher temperatures than organic infusions without destroying any possible productivity; and because in using them there would be a closer approximation to the conditions that must have existed when the surface of our earth first cooled down below the temperature of boiling water, so that a natural origin of living matter might thereafter become possible.

After sterilisation the sealed experimental vessels are exposed to diffuse light and a varying amount of actual sunshine for periods of from four to ten months or more before the contents of the tubes are examined microscopically, though the terminal month may, with advantage, be passed in an incubator at some temperature between 27° and 37° C.

When "controls" are opened, say any time within one or two weeks of sterilisation, no organisms, except it may be one or two embryonic forms, are to be found, especially if the solution of ammonic tartrate has been filtered through No. o Swedish paper, though when other tubes of the same series come to be examined after the several months of exposure to light and heat above mentioned many well-developed organisms are often found, which can be proved to be living.

These organisms are for the most part Torulæ, and minute simple moulds of different kinds. Specimens of such organisms are shown in Fig. 1, as they were taken direct from the tube, the Torulæ in this case being unusually abundant.

Bacteria are much less frequently met with, mostly motionless, though occasionally motile. Plasmogenic products simulating cocci and bacilli in appearance are also by no means uncommon in these colloidal silicate solutions.

According to De Barry and other authorities, no germs of moulds can survive a single immersion for a few minutes in water at 100° C.; while Torulæ are uniformly admitted to be killed by immersion for a minute or two in water at 60° C.

I have ascertained that the mixed Torulæ and fungus-germs to be found in the bloom on the surface of grapes have been killed by immersing the grapes for only *thirty seconds in boiling water.*[1]

[1] See "The "Origin of Life," 2nd edition, p. 96 (Watts and Co.)

Further, I have found that the Torulæ and minute moulds that tend to appear after a short time in unheated weak solutions of silicic acid are, like other fungus-germs, unable to survive a single boiling for five minutes. Yet the least severe sterilising heat employed in my experiments has been a boiling for twenty minutes on three successive days.

Objections and Replies Thereto.

Those who rely upon existing evidence as to the thermal death-point of such organisms as have been found within my tubes (rather than like Sir E. A. Schäfer pinning their faith to mere preconceptions as to the impossibility of the origin of living matter in these particular solutions) will agree that the sterilising processes employed by me should have been very much more than adequate to kill any germs of Torulæ or moulds that may have pre-existed within the tubes.

Those who are incredulous as to my results are compelled, therefore, to fall back upon one or other of the three following objections:—

(1) There are first the mere surmises of superficial objectors who postulate contaminated pipettes, or the dropping of organisms on to the microscope slide from the atmosphere before the application of the cover-glass. These are puerile objections against a prolonged research such as mine. Of course, pipettes

FIG. 1.—Large Group of Torulæ as taken direct from tube. No. 289. × 500.

have been carefully sterilised immediately before use; and as for the dropping of organisms from the atmosphere, such objectors would find it hard enough, if they tried, to find definite kinds of organisms, and often numbers of them (as in Fig. 1) on slides and under cover-glasses prepared by themselves. The next paragraph, however, will show the unreality of these mere surmises.

(2) It is assumed by many that the bodies found by me in my tubes are not really organisms. It is thought that they must be mere plasmogenic simulacra of living things, such as Leduc, Herrera, the brothers Mary, and many others have found in silicate solutions. This objection has been made over and over again. It is true that such bodies are occasionally to be met with in my solutions, and however important these mere simulacra may be as intermediate products between living and non-living matter, the other bodies which I find are not of this order. Those who have seen some of my tubes opened, and the bodies in question taken therefrom, such as Profs. Hewlett and Shattock, Profs. Farmer and Blackman at the College of Science, and several others, are unable to doubt that they have seen actual organisms taken from the tubes.

Moreover, on August 18 I received a letter from Paris written by two celebrated plasmogenists Albert and Alexandre Mary, in which they told me that they had confirmed my experiments. Following my directions implicity, they had, after some months, found typical Torulæ and Micrococci within the tubes, and had convinced themselves that they were actual living organisms. Thus, in regard to the latter, they say: "les ayant inoculés dans des solutions de glucose à 2 per cent. avec une légère quantité de lactate de fer, les microcoques plus haut décrits ont proliféré d'un façon remarquable, et la culture a offert l'aspect d'un sédiment se réunissant au fond des tubes."

This adhesion to my views by Albert and Alexandre Mary should be a complete answer to the second objection, so often formulated, that the bodies found by me were only plasmogenic products such as Leduc, Herrera, they themselves, and others had previously described as occurring in colloidal solutions, and should go far towards meeting the final doubt—the only one open to those who in this country have seen what they believed to be actual organisms taken from my tubes, namely the doubt whether the organisms, which they were bound to recognise as such, were still living.

(3) This brings me to the final objection advanced by some. They admit that many at least of the bodies that have been photographed are organisms, but believe them to be merely organisms that pre-existed in the solutions, and which, when found, were dead, having been killed by the sterilising process to which the tubes had been submitted.

As to this, it must never be forgotten that minute organisms are either very scarce or not to be found at all in "control" tubes opened soon after sterilisation, and to be often abundant after months in other tubes of the same series which have been exposed to light and heat and which had never previously been opened. If they were not there at first, and are there in numbers subsequently, how are we to resist the conclusion that they are living, and that *they have developed and multiplied within the previously sterilised tubes?*

In illustration of this important point I may state that I have recently received from New York two slides containing swarms of stained bacteria. These were taken by Dr. Jonathan Wright, the director of the Post-graduate Laboratories there, and his principal bacteriologist, Dr. MacNeal, from tubes which they had prepared and sterilised. They had been repeating my experiments, at first with negative results—even though three of their tubes had been inoculated with a culture of the hay bacillus previous to the triple heating. The organisms on the slides sent to me had been taken from tubes of two other series—one of them sterilised fifteen months, and the other four and a half months previously. The experimenters had some doubts at first whether the very numerous bodies on the first slide were really bacteria, though no such doubt was entertained by Dr. Hewlett or myself. In the second case they reported that they had found what were unquestionably bacteria in "enormous numbers." They now, at first, inclined to the belief that notwithstanding their enormous numbers the bacteria found must have been "in the original materials." But in the last letter received from Dr. Wright he reported that they had made a bacteriological examination of the materials in question with negative results. He adds: "So far as we have gone, therefore, we cannot take refuge in the supposition either that these organisms are crystalline simulacra of life, or that they were derived from the original materials, and were killed but not disintegrated by the triple heating. We have no suggestion to make other than your interpretation, and indeed we desire to be entirely non-committal as yet."

I am, therefore, waiting for information concerning the examination of other tubes of these two series.

These facts would seem sufficiently to answer the third objection now under consideration. Still, one very remarkable example of this kind ought to be cited. A series of five tubes containing sodium silicate and pernitrate of iron was boiled for twenty minutes on May 17, 18, and 19, 1912, and these tubes were exposed to light and heat in the usual way. At the expiration of seven and a half months (December 9, 1912) I opened one of these tubes, and took from it a small amount of reddish sediment, similar to that which existed in each of the others. On microscopical examination I found in this sediment two minute masses of mould associated with compound spore-like bodies such as I had never seen before. I sent the specimen to an eminent authority, Mr. Geo. Massee, of Kew, and was told that the mould with its peculiar spores was allied to the genus Oospora. At the end of February of last year another of these tubes was opened by Profs. Hewlett and Shattock; early in March one was opened by me in the presence of Profs. J. B. Farmer and V. H. Blackman; and in May another was opened by me in the presence of some bacteriologists and chemists at the Lister Institute, and in each case more or less of the characteristic Oospora spores were found. The mycelium was not in each case found, and I know that some of the observers were sceptical as to the nature of the spores.

FIG. 2.—Portion of a large tuft of mould (Oospora) which was seen growing at the bottom of tube No. 358. ×325.

The last of these tubes was kept by me for some future occasion, and was not again particularly noticed until July 22. Then, on examination of the unopened tube, much to my surprise there was to be seen at the bottom, by the side of the sediment, two tufts which had all the appearance of being moulds, one of them about half an inch in diameter and the other smaller. These were seen by many others, in the unopened tube, who took the same view as to their nature. On October 3 this tube was opened by Prof. Hewlett in his laboratory, and he took therefrom, as I expected, some of the Oospora. Portions subsequently taken by me were photographed, and one of them is shown in Fig. 2. That this mould had grown within the sterilised tube is perfectly clear; yet several of those already mentioned had failed in their various efforts to obtain cultures from samples that were found in the other tubes.

Successful cultures of organisms obtained from the tubes may occasionally be obtained by inoculating some of the organisms found into sterilised 3 per cent. glucose or ammonic tartrate solutions. Torulæ will often multiply or moulds will develop as a result, after several days, in such solutions. Fig. 3 shows a number of Torulæ which had thus multiplied within a glucose solution after six days.

Another and a more ready means of proving that the organisms taken from the tubes are living has been commonly adopted by me. The cover-glass of the microscope slip on which they are contained, is at once ringed with paraffin melting at 40° C., and the slip is then put aside in a warm place for a few days. Fig. 4 shows a portion of a mould that had developed, and Fig. 5 shows Torulæ that after several days had greatly multiplied, under such conditions. Why the taking of the organisms out of the tube, and placing them between two layers of glass surrounded by paraffin should so greatly favour their development I am unable to say, but that it does do so I am perfectly certain. I will cite one very striking instance that I observed a short time since. In some of the sediment taken from the centrifuged contents of a tube, I found, beneath the cover-glass, during a thorough examination, about forty to fifty minute solitary bodies like embryo Torulæ. The cover-glass was ringed and the slide put aside. When I examined it again after only thirty hours, in place of the solitary bodies groups were seen of larger bodies from which hyphæ were being developed in almost all cases. I have several photographs illustrating this, and one of the largest of the groups is shown in Fig. 6, while another group is shown in Fig. 7, as seen some days later, under a lower magnification, but in which the hyphæ had grown considerably longer. The tube had been prepared and sterilised many weeks previously, and during that time within the tube only very minute solitary bodies had been produced. But in thirty hours after having been taken out of the tube and placed beneath the cover-glass they grew, they multiplied, and developed hyphæ, as shown by the photographs.

FIG. 3.—Torulæ from 3 per cent. glucose on sixth day after its inoculation from tube No. 437. ×500.

FIG. 4.—Mould from 3 per cent. glucose on ninth day after its inoculation from tube No. 557. ×500.

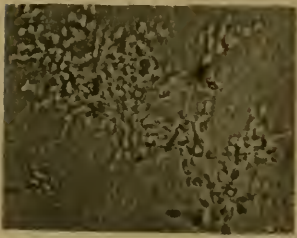


FIG. 5.—Large mass of Torulæ as found beneath a ringed cover-glass on fourteenth day, from tube No 438. ×500.

From the evidence above detailed it seems very difficult to resist the following conclusions:—

(1) That the bodies alleged to have been taken from the experimental tubes have really been taken therefrom, and are not mere accidental products which have dropped from the atmosphere during the transit of the sterilised pipette from the tube to the microscope slide.

(2) That the bodies in question are actual organisms, and not mere plasmogenic simulacra of living things, such as are often to be found in colloidal solutions.

(3) That they are actual living organisms which, as shown by the evidence of the "control" tubes, have increased and multiplied within the tubes, and will often behave in a similar manner after they have been taken from the tubes and placed under favourable conditions.

FIG. 6.—Multiplication and development of fungus germs from tube No. 631, after thirty hours under ringed cover-glass. ×500.

(4) That as all the organisms in question have been shown to be killed by a brief single exposure in fluids to the temperature of boiling water (100° C.), none of them, even if present, could have survived the much higher or much more prolonged heatings to which the tubes and their contents were exposed during the process of sterilisation—that is to say, these tubes should have been after that process as devoid of living things as was our earth in the far remote past, and just as then, at some period, there must have been, as is now generally admitted in the world of science, a *de novo* origin of living matter on the previously lifeless earth under the influence of purely natural causes, so now it would seem that the simple living organisms which appear within the experimental tubes must have been produced, *de novo*.

FIG. 7.—Further development of another group of fungus-germs under the same cover-glass, as seen six days later. ×325.

under the influence of physico-chemical processes of the same order as those that must have been operative in the past.

* * * * *

In my work entitled "The Nature and Origin of Living Matter," an abridgment of which has been published by the Rationalist Press Association,[5] I have considered the question of "spontaneous generation" from a broader point of view (pp. 128–141), and have endeavoured to show how multitudes of facts can be explained in accordance with my views, that from the time when living matter first appeared upon the earth it has probably ever been constantly re-appearing, as at present, and giving birth to the simplest living units, such as now swarm upon its surface. These processes are such that they must always take place beyond our ken, seeing that they necessarily begin with mere molecular collocations, gradually going on to the formation of particles of an ultra-microscopic order. Such infinitesimal particles gradually emerge into the region of visible things as revealed by high powers of the microscope, and take on this or that simple organic form in a manner that (though by processes much more complicated) is somewhat akin to the mode by which crystals emerge from different mother liquors, and take on this or that particular crystalline form.

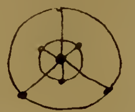
Thus, while the fact of the present occurrence of the *de novo* origin of living matter is, in my opinion, beyond the region of doubt, I fully recognise that the actual steps of the process remain to be discovered. I have elsewhere[6] referred to some of the probable steps of the process, and the prominent part that may be taken by inorganic catalysers under the influence of sunlight, and in some quite recent experiments by Prof. Benjamin Moore and J. A. Webster, in a paper entitled "Synthesis by Sunlight in Relationship to the Origin of Life,"[7] they have been able to demonstrate the probable actual first step of such a process—one that is known to occur as a first step in the nutrition of plants. We are, however, as yet only on the threshold of anything like an explanation of the various stages of this supreme mystery, for the unravelling of which philosophers and chemists have hitherto striven in vain. As with many other natural phenomena, the fact of the occurrence of which cannot be questioned, so here only conjectures are available as to the precise mode in which it may have been brought about. We must, however, repose our faith in the uniformity of natural phenomena, as one of the cardinal postulates of science, and if living matter had a natural origin in the far-distant past, there is, from that point of view, good ground for believing what our experiments seem to testify, that it also occurs at the present day.

H. CHARLTON BASTIAN.

[5] Watts and Co., 1910.
[6] "The Origin of Life," 2nd edition, 1913, pp. 61–65.
[7] Proceedings of the Royal Society, B. 593, p. 163.

Atomic Models and X-Ray Spectra.

IT is universally assumed that the atom of an element can form a Saturnian system with more than one ring of rotating electrons, and this idea is used in particular by Moseley in the theoretical discussion of his recent experiments. But in an Adams prize essay, not yet published *in extenso*, this is shown to be impossible. If the law of repulsion between two electrons, or of attraction between electron and nucleus, is that of the inverse square, more than one *coplanar* ring cannot exist. All the electrons in any plane must lie in the same ring, and even if they are in different planes, the radii of the rings must be nearly equal. A consideration of a simple case will illustrate this. For example, it is at first sight probable that the system in the accompanying diagram,



consisting of two coplanar rings of three electrons each, symmetrically arranged with all the angles equal to 60°, can exist with some angular velocity ω, if the radii of the outer and inner rings are a and b, the latter being much smaller than a. But it is easily shown that the conditions of steady rotation of such a system are—

$$\frac{m\omega^2}{e^2} = \left(N - \frac{1}{\sqrt{3}}\right)\frac{1}{a^3} - \frac{1}{a(a+b)^2} + \frac{b-2a}{a} \cdot \frac{1}{(a^2+b^2-ab)^{\frac{3}{2}}}$$

$$= \left(N - \frac{1}{\sqrt{3}}\right)\frac{1}{b^3} - \frac{1}{b(a+b)^2} - \frac{2b-a}{b} \cdot \frac{1}{(a^2+b^2-ab)^{\frac{3}{2}}}$$

and the resulting equation for the ratio b/a has only *one* root $b/a=1$, whatever value be attached to N, where Ne is the charge on the nucleus. Any other simple case which is tried will be found to lead to the same conclusion.

This conclusion not only belongs to any ordinary dynamical theory of the rings, but to Bohr's theory also. For Bohr supposes that the *steady rotation* of the system can be derived by ordinary mechanics, and, in fact, the equation so derived is vital to his formula for spectra. If Bohr's theory is to remain—and it is so attractive that its retention is desirable, in the writer's opinion—we must give up the idea of concentric rings in the atom, with X-radiation coming from an inner ring. For any way of avoiding the present conclusion, for example, by making a change in the law of attraction in the immediate neighbourhood of the nucleus, at once destroys the formula on which Moseley bases his view that his experiments support Bohr's theory.

How then, if there is only one ring of electrons, and if X-radiation is due to a ring—a point on which Moseley has given a cogent reason for doubt—does X-radiation originate? The answer is that without a serious reduction in its radius, the single ring may, on Bohr's theory, give radiation of the X-ray type. For Bohr's spectral formula for an atom with nucleus Ne and n electrons is

$$\nu = \frac{2\pi^2 me^4}{h^3}(N - S_n)^2\left(\frac{1}{\alpha^2} - \frac{1}{\beta^2}\right)$$

where α in the Balmer series is 2, and β takes integral values. But the principal line given by the formula corresponds to $\alpha=1$, $\beta=2$, and its wave-length in cm. is at once found to be

$$\lambda = \frac{1215{\cdot}7 \cdot 10^{-8}}{(N - S_n)^2}$$

To obtain a wave-length $\lambda = 3{\cdot}368.10^{-8}$, Moseley's value for calcium, we only require $N - S_n = 18{\cdot}98$, which Moseley interprets as meaning $N=20$, $n=4$. Thus a ring which gives the ordinary hydrogen spectrum when $N=1$ can give an X-ray spectrum when $N=20$, in spite of the enormous difference of wave-length concerned. But the *radius* would not be so widely different in the two cases. For in the normal atom it is inversely as $N - S_n$, and since on Bohr's view, the radius of a hydrogen atom is $5{\cdot}5.10^{-9}$ cm., that of calcium would be $3 \cdot 10^{-10}$, quite a possible value.

There is ground, accordingly, for retaining Bohr's theory, if only one ring exists, and then the calcium X-ray spectrum means exactly the same thing as the ordinary hydrogen spectrum, and no element should show such X-ray spectra until N becomes large. The X-ray or Balmer spectrum of helium, for example, would have a principal line, $\lambda = 6945 \cdot 10^{-8}{}_{\mu}$, between the ultra-violet and the X-ray regions.

But there is a serious difficulty. If $N=20$, $n=4$, where are the other 16 electrons required to make the atom neutral? Perhaps it is more reasonable to suppose that N for calcium is higher, and given by $N-S_N=19$. In this case, N would not denote the place of the element in the periodic table, but would allow for intermediate and unstable forms of matter—an allowance which may well be necessary. The only alternative is to explain X-rays by the structure of the nucleus. Any internal ring must be one of doublets, such as neutral α particles.

There is one other point to which I must refer. Mr. Moseley states that he has not found a correspondence between the X-ray spectra and the vibrations of the element nebulium treated in one of my papers. This correspondence is not to be expected, for the two investigations are unrelated. The simple-ring atoms which I have used to interpret astrophysical spectra are supposed to have a *simple* nucleus, or to contain no α particles, and to be incapable of giving series spectra. They are not identical with ordinary atoms, into which, however, they appear to change in the stars which follow nebulæ in order of evolution, and, as is shown in a paper in the *Monthly Notices of the R.A.S.* for December last, almost certainly by a modification of their nuclei. When this change occurs, they show series spectra, which must depend on the nucleus, and perhaps on tubes of force, in a way which a mechanistic interpretation of Bohr's theory may perhaps explain. In a paper read at the January meeting of the Royal Astronomical Society, these series were shown to lead to the same conclusion as Bohr's with regard to the nature of a hydrogen atom.

J. W. NICHOLSON.

University of London, King's College.

Prof. Turner and Aristotle.

IN *The Times* report of December 29, 1913, of Prof. Turner's lecture at the Royal Institution, his remarks on Aristotle are summarised in a way which will surely appeal to his sense of humour after his astonishment at my letter has abated.

"Aristotle said that a weight of 10 lb., for example, fell ten times as fast as a weight of 1 lb., and the world went on believing it for 2000 years. This raised the question whether it was better to believe things just because people told one, or to try to find out for oneself."

Aristotle never said this at all. Who first fathered it on to him will perhaps never be known now, but since Galileo made the statement notorious 323 years ago, the world has gone on believing it. If anyone wishes to find out for himself, let him consult the Teubner stereotyped Greek edition of Aristotle's "Physics," Book IV., cap. viii., sect. 8–11, or the Leonine edition of St. Thomas Aquinas's "Opera Omnia," tome ii., commentary on Aristotle's physics, texts 71 and 74, pp. 183–7. It is in the British Museum.

Aristotle is discussing the notion of a vacuum, and using the argument from motion. Lection xi. in "Opera Omnia," containing the argument, begins on p. 180, and is headed, "Ex parte motus ostenditur non esse vacuum separatum." An intelligible paraphrase of the important parts of texts 71 and 74, or sect. 8 and 11, is as follows: "§ 8: We see that a heavy body is borne (or translated) faster for two reasons, either because of differences in the medium through which it passes, as earth or air or water, or other things being equal, because the body itself differs by reason of its superior gravity or buoyancy. As regards the medium, the reason is that it resists. . . . If air is twice as subtile as water, then for an equal distance the time of translation in water will be twice that in air. . . . § 11: As regards differences in the body itself. We see that those bodies which have greater potentialities of movement (ῥοπήν, inclinationem), whether downwards by reason of their weight, or upwards by their buoyancy, other things being equal as regards their shape (σχήμασι, figuris) are translated quicker over equal spaces, and this according to their proportionate magnitudes. But why should this be so in a vacuum? Therefore a vacuum is impossible. But why is it that they have different rates of translation? In a plenum it is indeed of necessity, for that body which is the faster, is so by reason of its power or of its shape or of its potentiality of motion whether of translation or projection, whereby it divides the medium more effectively. But in a vacuum all are equally effective, so that all are faster than one another. Which is impossible." § 11 is usually relied upon to convict Aristotle of error, but it is evident that motion through a resisting medium is premised.

The commentary of the Angelic Doctor makes this quite clear. The reader will find, probably to his amazement, that the new and modern notions of velocity were explicitly present to his intellect when he wrote. Special attention may be directed to § 13 of the commentary on p. 187, beginning "Deinde eum dixit, Secundum autem eorum." He actually used the words, "vel propter aptitudinem figurae quia acutum est penetrabilius," just as though he was describing the peculiar property of a modern pointed bullet. In the new and technical language of gunnery "motus" or "motus naturalis" is rendered precisely by the expression, "terminal velocity," the velocity at which the retardation of the medium, air, is exactly equal to the acceleration of gravity, resulting in a constant speed of fall. That Aristotle ever supposed for an instant that a 2-lb. weight fell, in the ordinary sense of words, twice as fast as a 1-lb. weight is an absurdity. What he taught was that the terminal velocity of a heavy body, such as Prof. Turner's sovereign, was greater than the terminal velocity of a light body, such as a feather, in a medium such as air or water. A penny can never fall faster than about 30 ft. a second through air. I performed the experiment last week, dropping pennies from Clifton Bridge, 250 ft., into the Avon. They take eight or nine seconds to reach the water. Sir George Greenhill has often expressed doubts to me as to the correctness of the accusation against Aristotle's common sense, but could never persuade a scholar to find the passage. A year and a half ago he showed me the above reference in the introduction of Mr. Lones's new book on Aristotle's "Natural History," and asked me to look it up. I consulted St. Thomas's Commentary in the British Museum, with the startling result I have mentioned, and fetched my former professor over to the reading-room to verify my discovery. That he did verify it must be my apology as a soldier for intruding into the domains usually preserved for scholars and philosophers of the highest order.

J. H. HARDCASTLE.

27 Cranbrook Road, Bristol, January 9.

TEUBNER'S edition of Aristotle's "Physica" is out of print, but the equivalent passage is found in his Aristotle's "De Coelo" (C. Prantl), p. 73, where the law is enunciated that the terminal velocity of a body in a medium is proportional to the weight.

Aristotle's law was justified by Newton in his experiments in St. Paul's, repeated by Desaguliers, as described in the "Principia," lib. ii., prop. xl.

Aristotle is speaking of motion such as of a raindrop or hailstone falling vertically in the air, or of a smoke particle up the chimney; also of a stone dropping in water, or a bubble rising.

But in "De Motu Gravium Naturaliter Accelerato," Galileo is discussing the start of such a body from rest, while getting up speed, like a steamer or train from a station, when the motion is slow enough for resistance to be insensible, as he verified on the Leaning Tower of Pisa, dropping lead weights.

A train starts from the station with the full Galilean acceleration of the net pull of the engine, but as the speed and resistance increases the acceleration falls off, and finally, at full speed for the most part of the journey, Aristotle's state of motion is attained, and the inertia is eliminated, in the language of the engineer.

Galileo versus Aristotle can be shown off in a tumbler of soda-water, where a bubble starts up from the bottom with double Galileo's gravity acceleration, but before it reaches the surface the velocity has attained very nearly the terminal velocity of Aristotle.

I hope Capt. Hardcastle will be encouraged to devote his learned leisure to the preparation of a "Defence of Aristotle's Dynamics," on the lines of Duhem's recent book, "Les précurseurs parisiens de Galilée."

G. Greenhill.

1 Staple Inn, W.C., January 14.

Tungsten Wire Suspensions for Magnetometers.

Owing to the troublesome changes of zero and torsion constant of the silk suspensions of magnetometers, experiments have been made at the Royal Observatory, Greenwich, with the view of finding a satisfactory substitute. Quartz fibres were first tried, but were too rigid in proportion to their tensile strength. Success has, however, been obtained with tungsten wires such as are used in metallic filament electric lamps. These were suggested to us by Mr. F. Jacob, of Messrs. Siemens Bros., who kindly obtained various samples of wire for us; of these a tungsten wire of circular section, and diameter 20 microns, has been adopted as the suspension for our declination magnet, which is of the ordinary Elliott pattern, weighing about 50 grams. This wire, about 25 cm. in length, has now been in use for five months, during which time its zero has not changed within the limits of measurement, *i.e.* certainly less than 10″; the effect of 90° torsion on the wire is to turn the magnet through 4′ (it may be noted that a thicker wire, of diameter 51 microns, which was also tried, gave a deflection of the magnet of more than 2° for 90° torsion).

This success encouraged us to try a similar wire for the vibration experiment in the determination of absolute horizontal force, also with satisfactory results. The deflection of the magnet for 90° of torsion is 5½′, and the zero is constant.

For determining the moment of inertia of the deflecting magnet the latter wire was too weak, the inertia bar doubling the weight carried. A wire of diameter 30 microns is therefore used for this purpose, in a separate box. The advantage of tungsten wire for moment of inertia experiments is that the torsion constant does not vary with the weight borne by the wire; with silk suspensions this is not so.

The ends of the wire are held by simple squeezing, the lower end being gripped between grooved metal cheeks held together by a screw collar just as previously for the silk fibres. Another device was adopted for the top end, consisting of a spring clip with a sliding collar; any method involving soldering is unsatisfactory. The wire used here can be bought for 3d. per foot.

S. Chapman.
W. W. Bryant.

Royal Observatory, Greenwich.

The Pressure of Radiation.

In his letter of January 1 Prof. Callendar gives his reasons for doubting the formula for the pressure of radiation as it is usually accepted. He makes use of Boltzmann's proof of the fourth power law for the complete radiation, extends it to each separate frequency, and deduces that the energy in every frequency ought to be proportional to the fourth power of the absolute temperature. Since this is known to be untrue he concludes: "Either Carnot's principle does not apply, or E/v is not equal to $3p$ for each separate frequency," and chooses the latter alternative. But it would appear that Prof. Callendar's use of Carnot's principle is somewhat questionable. For, in order to investigate the pressure in an enclosure it is essential to alter its volume, and any change of size will bring the Doppler effect into play and cause a small change in the frequency of the radiation. If this be taken into account, the result leads straight to the displacement law of Wien—$E_\lambda = f(\lambda T)\ \lambda^5$—and beyond this gives no information. Moreover, a recapitulation of Wien's work with a different law of pressure fails to give the displacement law, so that this law must be abandoned, if the pressure formula is to be altered.

Prof. Callendar wishes to change the pressure formula in the hope of accounting for the observed radiation curve without making an open breach with our present electromagnetic theory. In his paper in the October *Philosophical Magazine* he extends his conception of caloric from matter to æther, and obtains a formula which fits the radiation curve as well as Planck's. However, his work involves a certain constant, b, the nature of which he does not discuss very fully, and this constant appears to be identical with h/k in Planck's theory, so that "molecules of caloric" are very closely related to Planck's quanta. Thus the work, which has established that the electromagnetic equations lead inevitably to Rayleigh's formula, proves also that according to those equations b should vanish; in fact, that in any finite region of the æther there ought to be an infinite number of molecules of caloric. If my reading of his paper is correct, it would appear that in extending the caloric idea to the æther Prof. Callendar has invented a new and helpful way of regarding Planck's quantum hypothesis.

C. G. Darwin.

The University, Manchester.

"Atmospherics" in Wireless Telegraphy.

With reference to Prof. Perry's interesting letter on "atmospherics" in Nature of January 8, the following experience may be of interest.

Whilst at my instruments on December 12, 1913, I was tuning in the Eiffel Tower signals to read the 7 a.m. press news when the atmospheric disturbances became so great that Paris was entirely unreadable, the phenomenon continuing for fifteen minutes without cessation. The aërial was only 35 ft. high, and sheltered by other buildings.

Reginald F. Durrant.

121 Broadway, Cricklewood, N.W., January 19.

THE STRUCTURE OF THE ATOM.

THE earliest developments of the electronic theory led necessarily to the conclusion that in every atom in its normal condition there were contained electrons which could be detached from it by suitable agencies; these electrons were the same in respect of the only two properties attributed to them, charge and mass, whatever the atom in which they were contained. This conception of a constituent common to all atoms indicated for the first time the possibility of explaining the relationships described by the periodic law between the properties of different atoms; if similar atomic properties represent similar numbers or arrangements of electrons, any theory which would make these numbers or arrangements periodic functions of the atomic mass would explain in some measure those relationships.

The first attempt to frame such a theory was made by Sir J. J. Thomson; the structure which he proposed for the atom is so generally known that it may be described here with great brevity. Since an atom in its normal condition is electrically neutral, it is necessary, if the principles of electrostatics be accepted, that it should contain a positively charged portion, the total charge on which is equal and opposite to that of the electrons contained in the atom. Until recently there was no evidence whatsoever as to the form of this positively charged portion; accordingly, Thomson adopted provisionally the form most convenient for his purpose; he supposed that the positive charge was distributed uniformly over throughout a sphere, the radius of which was taken to be the same for all atoms. In addition, he assumed that the number of electrons in an atom increases regularly with the atomic mass.

The mathematical problem of determining the distribution of N electrons within such a uniformly charged positive sphere is capable of partial solution whatever the magnitude of N. It can be shown that certain distributions are in equilibrium, but it cannot generally be shown that it is only these distributions that are in equilibrium, nor can it be shown generally that the equilibrium is stable. The problem of calculating from Thomson's assumption the structure of an atom is therefore not completely determinate; but if it be assumed that the distributions which can be calculated are unique and that they are stable, certain conclusions can be reached. If almost any other assumption concerning the distribution of the positive charge on the atom is made, even this small amount of progress is impossible. Thomson showed that the distributions which could be calculated were those in which the elecrons were arranged in circular rings, and that the number of electrons in any ring (*e.g.*, the outermost or the innermost) was a periodic function of N, and therefore of the atomic mass.

Before any theory of this kind can be regarded as complete, it must be shown that certain distributions of electrons are connected with certain properties of the atoms containing them, and it must be shown that the same distribution of electrons is connected with the many different properties which are found to be associated in similar elements. It must be shown, for example, that a certain distribution (which is to be identified with an atom of the alkali metals) is necessarily connected with electro-positive chemical characteristics, metallic conductivity, a special type of spectral series, and so on. It is necessary that the theory should explain the relation between different properties of the same element as well as that between the same property of different elements. Thomson endeavoured to correlate certain chemical properties with certain electronic distributions by showing that some of these would be likely to lose electrons, leaving the atom positively charged, while others would be likely to gain them; a difference in the tendency to lose electrons would probably lead to a difference in respect of metallic conductivity. But in no case could any observed atomic property be calculated with quantitative agreement from one of the supposed electronic distributions. The failure was especially important in the case of spectra, for the frequency of the vibration of the electrons could be definitely calculated in some cases, and it appeared that the relation between the frequencies of different vibrations in the same atom was not at all of the same form as that indicated by the known spectral series.

However, there was no definite evidence for disbelieving the assumptions underlying Thomson's theory until investigations were made on the scattering of α and β rays. These rays consist of charged particles which can certainly pass through atoms, and it is to be expected that in their passage they should be deflected by forces exerted between them and the electrons or the positive charge in the atom; by examining these deflections some indications as to the number of the electrons and the nature of the positive charge may be obtained. Rutherford and Geiger showed that the experimental results were quite irreconcilable with Thomson's theory, but that they were reconcilable with the view that the positive charge in the atom is concentrated on a single particle, like the electron of dimensions infinitesimal compared with the "radius of the atom"; the number of electrons in an atom must be taken as about half the number representing the atomic weight, the total charge on the "positive nucleus" being, of course, equal and opposite to that on all the electrons.[1]

The assumption that the whole positive charge on an atom is concentrated on a single positive particle had previously been suggested by Nagaoka, but it presents very great difficulties; for it is quite certain that, if the principles of mechanics and electrostatics are true, no collection of electrons round a positive nucleus can possibly be stable, unless all the electrons fall into the nucleus forming a single infinitesimal neutral particle. It has recently been proposed to

[1] Thomson had already advanced several lines of argument indicating that the number of electrons in an atom was not very different from its atomic weight, referred to that of hydrogen as unity.

solve this difficulty by denying that the principles of mechanics are true in their application to systems of atomic dimensions. Such a solution may appear heroic rather than practical to those who have not followed the trend of modern physics; those who have know that it is completely in accordance with the recent development of our ideas. The new conceptions which were first introduced by Planck's theory of radiation, and have been applied with such striking results to the theory of specific heats and elasticity, are directly contradictory of those of the older mechanics. They involve the recognition of a new "universal constant" (usually denoted by the symbol h), which, like the charge and the mass of the electron, is characteristic of all forms of matter. The source of many of the difficulties connected with the theory of a "positive nucleus" is that such a theory does not introduce sufficient quantities to determine an atomic structure; it introduces only the charge and mass of an electron, and from such quantities neither a length (such as the distance apart of the electrons) or an energy can be deduced. Thomson's theory rejects the "positive nucleus" and introduces another quantity, the radius of the atom, but there is no reason to believe that it is a "universal constant." The newer theories accept the "positive nucleus" and introduce the "universal constant" h in place of the radius of the atom.

Of these theories, that of Bohr is the most definite. This is not the place to describe the precise assumptions made by this theory; it is sufficient to say that they are simple, plausible, and easily amenable to mathematical treatment; from them all the properties of any atomic system which does not contain more than one electron can be deduced uniquely.[2] There are probably only two such atomic systems experimentally realisable, the neutral hydrogen atom and the helium atom, bearing a single positive charge. Bohr has calculated the spectra of these systems and obtained results which are in exact quantitative agreement with observation; in respect of other properties, the agreement between calculation and experiment is as close as can be expected in view of the doubts connected with the exact connection between these properties and a distribution of electrons. The properties of more complex atoms cannot be calculated with certainty, owing to the mathematical difficulties involved. Indeed, theories of atomic structure will probably never be very interesting to chemists, for our powers of explaining in detail the properties of systems so complex as the heavier atoms must be are closely limited by the powers of mathematical analysis.

Bohr's theory explains more than any previous or rival theory, but it does not explain everything. It introduces many novel assumptions, of which some are quite dubitable, and may have to be abandoned. Its great interest lies rather in the nature of the ideas which it introduces than in the exact explanation of atomic properties to which it leads. It not only rejects the principles of mechanics, which the most conservative are being slowly driven to abandon, but it indicates that fundamental propositions are to take their place. To attempt to explain Bohr's theory in terms of those principles is useless; it is impossible to explain why certain propositions are not true by assuming that they are true. There are only two alternatives open to the modern theoretical physicist: he may either suppose that the principles of the older mechanics are true, and that all the brilliant results which have followed from the application of the conceptions of Planck and Einstein to the most diverse phenomena are illusory and devoid of evidential value; or he may suppose that they are not true. Bohr's theory offers him the choice in its most striking form. Norman Campbell.

[2] One of the assumptions originally proposed by Van den Broek is especially interesting. It is that the number of electrons in an atom in its uncharged state is equal to that representing its position in the series of elements arranged in order of their atomic weights. Thus hydrogen has 1 electron, helium 2, lithium 3, and so on. This simple assumption leads to the result that the number of electrons is about half the atomic weight, and, of course, it gives a simple reason for that relation.

THE AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION.

The eighty-fourth meeting of the British Association will be opened in Adelaide on August 8, 1914, under the presidency of Prof. W. Bateson, F.R.S. On four previous occasions the association has met outside the British Isles; three times in Canada, and once in South Africa. Now, for the first time, a visit is to be made to the most distant portion of the Empire.

The invitation was conveyed at the Sheffield meeting in 1910 by the Australian High Commissioner and Prof. Orme Masson, F.R.S., acting on behalf of the Commonwealth Government. Since then arrangements have been proceeding for the fitting reception in the various Australian States of a considerable body of visitors from Britain. The sum of 15,000*l.* has been set aside by the Federal Parliament to defray the ocean passages of at least 150 members; in addition, the Government has undertaken the issue of a large handbook of permanent scientific value which will contain contributions by Mr. G. H. Knibbs, C.M.G., Hon. T. Pearce, M.P., Profs. Baldwin Spencer, F.R.S., Edgeworth David, F.R.S., Harrison Moore, and many others. The State Governments are giving active support in granting railway facilities, issuing handbooks supplementary to the larger Federal work, and in making direct contributions to the local expenses of the meeting; whilst, of course, every university is most heartily adding its full assistance.

Official meetings will be held in Adelaide (for four days), Melbourne (seven days), Sydney (seven days), and Brisbane (four days), extending from August 8 until September 1, but the ordinary proceedings of sections will take place in Sydney and Melbourne only, three sessions being held in each city. Western Australia is not included in the itinerary of the main body of visiting members, but special arrangements are being made for an advance party of seventy to visit that State between July 28 and August 4. This party will be provided by the Government with passes on the railways, and will spend its whole time in scientific study of the geology, botany, and zoology of the districts readily accessible from Perth. The Irwin River coal beds, the goldfields, the caves at Yallingup, Bunbury, and other places will be visited.

So far as it is at all possible, official functions in the Eastern States will be limited in number, and members will be given considerable opportunity to see the country within reasonable distance of the capitals. The week-ends are to be kept for this purpose throughout, and those who feel equal to further travelling after the long journeys between the main centres will find abundant outlet for their energies on the excursions which have been planned. From Adelaide a small party will visit the mines at Broken Hill; others will proceed to the Sturt and Hallett's Cove, while numerous trips of shorter distance are arranged. From Melbourne, visits will be paid to the National Park at Wilson's Promontory (a sanctuary for native game), to the gold districts of Ballarat and Bendigo, and to the glacier formations of Bacchus Marsh. Sydney supplies many interesting and lengthy excursions for its week-end, and its local committee has kept from the Friday evening until the following Tuesday morning quite free from formal gatherings. The Federal Capital site, the huge Burrinjuck Reservoir, the Cobar Mines, the Jenolan Caves, and the Maitland coal district are among the places offered for the traveller's choice. From Brisbane the Nambour and Blackall ranges will be visited, also the Gympie Mines and the Ipswich Engineering Works. For those specially interested who can remain a short time after the conclusion of the meeting, excursions to Mount Morgan, Townsville, and more distant places will be possible.

It has been a difficult matter to include in the programme so much touring and yet to do justice to the hospitality of official persons and bodies in the different States. Receptions and luncheons, together with the regular sectional meetings and the evening discourses, make a very full programme. The details of this were drawn up in Australia earlier in the year, and will before long be finally adopted with some amendments suggested by the council of the association. Prof. Bateson will deliver his presidential address in two parts at Melbourne and Sydney on August 14 and 20 respectively. The list of lecturers for the evening discourses, at present receiving the consideration of the council, is a long one.

It is interesting to learn that applications for inclusion in the oversea party, both from British and from foreign and colonial members, have been greatly in excess of all estimates. In fact, it seems likely that Australia's very strong desire that the whole party, without exception, should be treated as guests during their stay in the Commonwealth, must give way before the unexpectedly large number of visitors. Special arrangements have been made with steamship companies for reduced passage rates by way both of the Suez Canal and South Africa. Members will leave England about the end of June or the beginning of July. In the choice of route for the return journey, many possibilities are open, of which perhaps the most attractive is that *viâ* Port Moresby (the chief town in Papua), Darwin (in the northern territory), and three ports in Java.

In Australia the main directing body is the Federal Council, under the presidency of the Hon. the Prime Minister of the Commonwealth and the chairmanship of Prof. Orme Masson. Strong local committees are also at work in each capital. Quite independently, New Zealand is preparing to receive a small group of members at the conclusion of the Sydney session.

A great deal is expected from this visit of the British Association. In a prosperous and sparsely populated country where Nature bestows gifts readily and liberally, the application of scientific methods in the great primary industries seems to be less called for than it is under less abundant natural conditions. Hence, perhaps, the general appreciation of scientific labour, whether for its own sake or in the pursuit of material ends, is apt to be lessened. That Australians recognise the danger of this is attested by the cordiality, shown on every hand, of the invitation extended to the British Association. Australia requires and welcomes the stimulus of the association in its academic, economic, and industrial life, and it offers in return an exceedingly varied field for the observation and investigation of its visitors.

A REMARKABLE ANTICIPATION OF DARWIN.[1]

THE presidential address to the Linnean Society of London, delivered last May by Prof. E. B. Poulton, F.R.S., and recently published in separate form, deals with a truly astonishing work by G. W. Sleeper, printed, apparently, in Boston, U.S.A., in the year 1849, and containing an anticipation of modern views on evolution and the causes and transmission of disease, which, considering all the circumstances, is extraordinary.

The work, which is a small pamphlet of some thirty-six pages, was sent by an American gentleman, Mr. R. B. Miller, to the late Dr. Alfred Russel Wallace, who forwarded it to Prof. Poulton with an interesting letter quoted in the latter's address. Dr. Wallace justly observed that the author's "anticipation of diverging lines of descent from a common ancestor, and of the transmission of disease germs by means of insects, are perfectly clear and very striking."

It is well known that the idea of the derivation of species by descent, and even of the operation of natural selection, had occurred to other thinkers before Darwin. The passage cited by Darwin himself from the "Physicæ Auscultationes" of Aristotle shows, though its import has often been misunderstood, that the Greek philosopher had

[1] A Remarkable American Work upon Evolution and the Germ Theory of Disease. Address delivered by Prof. Ed. B. Poulton, President of the Linnean Society, at the anniversary meeting of the society on May 24, 1913.

before his mind the doctrine of natural selection. The medieval schoolmen were by no means wedded to the theory of special creation, and in the eighteenth and early nineteenth centuries the transformist view was freely canvassed, without, however, making much way among scientific thinkers. The "Historical Introduction" prefixed to the later editions of the "Origin of Species" gives an account of several anticipations, more or less exact, of the Darwinian theory.

But the present treatise goes far beyond most, if not all, previous attempts at solving the problem of evolution. The clear grasp shown by the author of the Darwinian principles of the struggle for life, and origin of fresh species by the preservation of those forms best adapted for their environment, his advocacy of the persistence of germinal characters, and the very terminology that he uses, might well suggest a doubt as to whether the pamphlet is really what it professes to be, or whether it is not, in fact, a cleverly devised fabrication with a falsified date. We find, for example, such expressions as the following:—"Life owes its faint beginning to primal germs . . . pervading the entire terrestrial atmosphere; and, perhaps, the entity of the Cosmos"; "everywhere about us we see waged the pitiless battle for life . . . the useless perish, the useful live and improve"; "Man and the Ape are co-descended from some primary type"; "The life germ resident in Man transmitted to his descendants goes on existing indefinitely." Here are anticipations, not only of Darwin, but also of Arrhenius, Galton and Weismann. Not less surprising are his enunciation of the germ-theory of disease, his experiments on the cultivation of streptococci from a sore throat, with the use as a germ-filter of cotton wool sterilised by heat, his suggestion of the action of phagocytes, and his recommendation of metal gauze protective frames for doors and windows in order to ward off infection carried by insects.

The question of the genuineness and authenticity of the pamphlet is carefully discussed by Prof. Poulton. The evidence on the point is perhaps not absolutely conclusive; but it may fairly be said that after weighing the interesting information brought together by Prof. Poulton respecting the book and its author, few will doubt that Mr. Sleeper's work was really printed and published at the time stated, and that it contains one of the most remarkable anticipations of modern views and forms of expression respecting evolution and the germ-theory of disease that have yet come to light.

F. A. D.

THE RECENT VOLCANIC ERUPTIONS IN JAPAN.

ALTHOUGH the resulting destruction of life and property has happily been far less than was indicated by the early accounts, yet there can be no doubt that a volcanic outburst of great magnitude has taken place in Japan. The vulcanologists of Tokyo have for some time past noticed indications of unrest in the vast crater of Asama, in central Japan, but it is on the fissure of Satsuma, at the extreme south of the archipelago, that the recent disasters have occurred. Of the four great volcanoes on this fissure the most northern, Kirishima (5538 ft. high), burst into eruption some weeks ago, and the outburst became paroxysmal simultaneously with that of Sakurajami. Sakurajami is an island mountain in the Gulf of Kagoshima, rising to the height of 3743 ft., with three apparently extinct craters eight miles distant from the town of Kagoshima. The only indications of volcanic activity up to the time of the recent outburst were some hot springs and a few steam jets appearing on the southern crater after heavy snow or rain. The island and adjoining portion of Kiusiu have long been famous for their fertility.

There may be some truth in the tradition that the volcano of Sakurajami was formed by a great eruption in 796 A.D., and it is asserted that no considerable outburst took place from it between that date and 1779, when an eruption accompanied by a great seismic sea-wave covered the five miles of water between the island and Kagoshima, so that people could walk across it. The general rule that a quiescence of long duration is followed in volcanoes by an eruption of exceptional violence is illustrated in this case, for the dormancy of the volcano after the outburst of 1779 has lasted 135 years.

Warning of impending disaster was given on January 10 by loud rumblings and earthquake shocks, and these increased in frequency and violence, so that on the following day they were noted as taking place at intervals of three to five minutes. On the morning of January 11 a rent was seen to be formed about one-third up the mountain side, a column of steam and dust being thrown up to the height of 1,000 ft., and this was followed by the appearance of three other fissures. In spite of assertions to the contrary, it is doubtful if lava flowed from either of these rents. Forty minutes later, eruption took place from one of the summit craters, a column rising to the estimated height of 2700 ft.

This outburst was accompanied by an earthquake felt over the whole island of Kiusiu, and a seismic wave on the sea, while volcanic dust fell on Kagoshima, where it accumulated to depths variously estimated from 2 to 15 ft.; the dust reached Nagasaki, 100 miles away, on January 13, and Tokyo and Yokohama, 600 miles off, on January 14. On this last date it is said that "the west side of the volcano blew out," and this was accompanied by another earthquake and seismic sea-wave. Whether this last occurrence indicates the formation of a larger fissure or a great new crater is not clear, and, although decline of the volcanic action is reported, it may be doubtful if the eruptions are yet really at an end.

(Telegrams from Japan, since the above was written, indicate that doubt as to the cessation of the eruptions was justified.)

NOTES.

Upon inquiry made shortly before going to press yesterday we learned with regret that Sir David Gill was not quite so well; his condition is still a cause of anxiety.

We record with regret the death on Wednesday morning, January 21, in his ninety-fourth year, of Lord Strathcona, High Commissioner in London for the Dominion of Canada, and Chancellor of McGill University, Montreal, and the University of Aberdeen.

The Imperial Academy of Sciences of St. Petersburg has elected Sir Edward Thorpe as a corresponding member.

Mr. G. W. Hess has been appointed to succeed the late Mr. C. Leslie Reynolds, as superintendent of the National Botanic Garden, Washington.

Mr. J. I. Craig has been transferred from the directorship of the meteorological section of the Egyptian Survey Department to the controllership of the Department of Statistics, and has been succeeded at the survey by Mr. H. E. Hurst.

Mr. W. D. Marks, formerly Whitney professor of dynamic engineering at the University of Pennsylvania, has died at the age of sixty-four. He had been consulting engineer to several of the leading American cities, and was the author of a large number of scientific reports and papers.

The death is reported, in his sixty-eighth year, of Dr. S. C. Chandler, of Wellesley, Mass. From 1864 to 1870 he served on the U.S. Coast Survey. He then spent fifteen years as a life insurance actuary. In 1896 he became editor of *The Astronomical Journal*. In recognition of his researches, Dr. Chandler had received the Watson gold medal, and the gold medal of the Royal Astronomical Society.

Mr. A. H. Cole, a well-known American writer and lecturer on biological subjects, has died at Chicago at the age of fifty-seven. He had been connected successively with the Peddie Institute, Colgate University, the University of Chicago, and the Chicago Teachers' College. He developed a method of demonstrating the movement of sap in the leaves of plants, and also a plan of teaching biology from living plants and animals with a projection microscope. He also made important contributions to the production of anæsthesia in animals used in zoological laboratories.

Recent American obituary includes the name of Prof. Winslow Upton, for nearly thirty years head of the department of astronomy at Brown University, Providence, R.I., and director of the Ladd Observatory since its erection in 1891. He was born in 1853, and held various posts in connection with the U.S. Lake Survey, the U.S. Naval Observatory, and the U.S. Signal Service, before receiving his academic appointment. He had taken part in several important eclipse expeditions, and in 1896–7 was absent on leave from Brown University for work at the southern station of Harvard University at Arequipa, Peru.

The City of London Entomological and Natural History Society and the North London Natural History Society have been amalgamated to form the London Natural History Society. Meetings of the new society are held at Hall 20, Salisbury House, Finsbury Circus, London, on the first and third Tuesdays of the month. The new society starts its career with 190 members and sixty associates, and it has branches at Chingford and Woodford. Mr. L. B. Prout is president, and Mr. T. R. Brooke, 12 Warren Road, Chingford, with Mr. J. Ross, 18 Queen's Grove Road, Chingford, are joint secretaries.

The late Capt. Scott's original journals written during his expedition to the south pole, have been placed on view in the manuscript department of the British Museum. The journals are to be exhibited to the public for an indefinite period, and it is to be hoped they may remain permanently in the British Museum. The records are contained in nine large notebooks, in which are the entries, written in ink, made on board the *Terra Nova* and after the party had landed at its headquarters; and six smaller books, of which three were used for the earlier sledging journeys, and three were taken to the pole.

The views of Mr. R. Mond on the desirability of feeding infants on raw milk and the little danger of tuberculous infection therefrom, referred to in Nature, January 8, p. 537, have, according to *The Times*, aroused considerable interest. Mr. Charles Bathurst, M.P., speaking at a meeting of the Gloucestershire Farmers' Union, expressed his concurrence with the views of Mr. Mond, and submitted that the Royal Commission on Tuberculosis in its final report had gone far beyond its own experiments in assuming that human and bovine tuberculosis are intercommunicable. Sir James Barr and Dr. Latham, on the other hand, consider that there is a real danger of contracting tuberculosis from raw milk.

A league, entitled the "Lega Nazionale per la Protezione dei Monumenti Naturali," has recently been formed in Italy for the protection of the fauna and flora of the country, and of such geological and geographical features as are of scientific and æsthetic interest. The existence of these objects of natural beauty and interest is now threatened from various sides, and to so great an extent that concerted action is necessary for their preservation. The headquarters of the league are in Rome, Prof. R. Pirotta, the director of the Royal Botanical Institute of Rome, being president of the organising committee. The association hopes to accomplish its object by the assistance of (1) an active propaganda, including publications, conferences, excursions, &c.; (2) legislative enactments for the safeguarding of natural objects of interest; (3) the establishment of reserves and national parks. The executive council includes a zoologist, a botanist, a geologist, a geographer, and an agriculturist.

The probability that another Antarctic expedition will be in the field at the same time and in the same quarter as Sir Ernest Shackleton's appears to afford reason for nothing but satisfaction, as the objects of the two are not mutually exclusive. Dr. Felix König intends to lead an Austrian expedition from Buenos

Aires in the middle of this year. His base will be in the Weddell Sea, and he has planned sledging expeditions for three parties in different directions for the exploration of the adjacent parts of the Antarctic continent, followed by an advance to the pole. His scheme, except in so far as it does not include a journey across the continent, as Shackleton's does, certainly resembles the latter closely, but it can scarcely be supposed that there is not room for both. Dr. König's expedition will carry a wireless telegraphic installation, and leave another in South Georgia. With his experience in the recent German expedition, and the advice of Count Wilczek and Capt. Amundsen, Dr. König is well fitted for success, and between Sir Ernest Shackleton's work and his the great physiographical problem of the relationship between the eastern and western parts of the Antarctic land-area should in two or three years be on the way toward solution.

The collection of the late Dr. Franklin Parsons, formerly of the Local Government Board Medical Service, has been left to the Croydon Museum, and consists of many thousands of geological, zoological, and botanical specimens. Unfortunately, the Corporation of Croydon has not at present seen its way to accept the valuable bequest. A proposal of the Roads Committee, which has the care of the park in which the Grange Wood Museum is situated, that the gift should be declined, was referred back, so that the collection might be examined by experts before a final decision is arrived at. A great deal of the collection is of considerable local interest. Some expense would be incurred for arranging and housing the collection, and there is a growing feeling that the oversight of the museum should now be transferred to the Libraries Committee, with a regular annual grant for its upkeep. The specimens now bequeathed are for the most part in good condition, and accurately labelled, and would be acceptable to any local museum. It is proposed by experts who are now examining the collection that the duplicates should be distributed amongst the schools in the borough, and no doubt in any case these will be greatly enriched by the bequest. An opportunity is now afforded of putting the Croydon Museum on a sound basis as regards upkeep and development.

The question of the systematic teaching of the principles of anthropology raised, not for the first time, by Sir R. Temple, at the Birmingham meeting of the British Association, has now reached a practical stage. The proposal, supported by distinguished administrators in India and the Colonies, finds further justification in the recent report of the Commission on University Education in London, which states that "it is almost as important that officials, and others intending to spend their lives in the East or in parts of the Empire inhabited by non-European races, should have a knowledge of their racial characteristics as that they should be acquainted with their speech, and we believe that the Colonial Office shares this view." The scheme now prepared by a committee provides for the collaboration of the Royal Anthropological Institute, the British Association, the universities, the Foreign, India, and Colonial Offices, and the Civil Service Commissioners, in supporting existing schools of anthropology, establishing them where they do not exist, and providing laboratories, libraries, and museums. In support of these proposals a meeting is announced to be held at Drapers' Hall, on Thursday, February 19, with the Earl of Selborne in the chair, when a deputation will be appointed to lay the proposals before the Prime Minister. The matter has been more than once brought before the Ministry, but never with such well-organised support; and it will be little short of a scandal if these representations fail to secure the adequate settlement of a question of great public importance.

A route by which it is possible to penetrate to the bottom of the Vesuvian crater, more than 1200 ft. below its rim, was discovered some time ago by Prof. Alessandro Malladra, and has already been utilised for the purpose of obtaining a kinematograph film. Mr. F. Burlingham, an American operator who had already shown his skill and boldness by getting a pictorial record of an ascent of the Matterhorn—accompanied by two of the "crystal-hunters" of Vesuvius, acting as porters, accomplished the difficult feat without misadventure either from stone avalanches or poisonous gases, and the results of the undertaking are now being exhibited in London. Although these results are more important from a spectacular than from a scientific point of view, yet there can be little doubt that Mr. Burlingham, by proving that not only can a descent be safely made, but that heavy apparatus may be conveyed to the crater-floor, has paved the way for scientific work, in which temperature observations, the collection of gases for analysis, and similar investigations may be carried out. In *The Times* of January 13 Mr. Burlingham has given, under the title, "Inside Vesuvius: Lessons from a Descent of the Crater," a very clear and modest account of his remarkable feat. He believes that his observations indicate that a new eruption of Vesuvius is more imminent than the officials at the observatory anticipate, but he at the same time admits that the formation of a lateral vent and flow of lava on the flanks of the mountain may falsify his predictions on the subject. The kinematograph has already proved its usefulness in many lines of scientific research, and may in the future render valuable aid in vulcanological studies.

Dr. E. T. Wilson, president of the Cheltenham Natural History Society, has published a useful paper on the long-barrow men of the Cotswolds. He gives a good summary of the excavations of a large series of barrows, describing their construction, and the furniture of the interments. The history of their builders, he remarks, "teems with contradictions and puzzles which will require for their solution the additional evidence to be obtained by the opening up of unexplored barrows in Gloucestershire and Wilts." But as much valuable material has already been lost by careless investigations, it may be hoped that future excavation will be deferred until it can be systematically undertaken by qualified experts.

To the June issue of the *Bull. Ac. Sci. Cracovie* for 1913, pp. 335–412, Mr. Jan Nowak contributes the third part of his illustrated memoir on the ammonites and other cephalopods of the Upper Tertiary of Poland, with descriptions of several new species.

According to the Zoological Society Bulletin (New York) for November, the longest, although by no means the heaviest, lobster on record was received at the New York Aquarium in September. It measured 38 in. in length, and weighed 21 lb.; in 1887 the aquarium received a specimen measuring 24 in. in length, and weighing 34 lb., this, so far as known, being the record for weight.

The affinity between the Tertiary mammalian faunas of eastern Europe and North America indicated by the occurrence of Titanotherium in the former area is strengthened, if the generic determination be correct, by Mr. Niezabitowski's reference (*Bull. Ac. Sci. Cracovie*, 1913, pp. 223–25), of an imperfect rhinoceros skull from the Pliocene of Odessa to the North American Tertiary genus, Teleoceras, under the name of *T. ponticus*. Although the upper teeth present considerable resemblance to those of *Aceratherium schlosseri* from Samos and *A. blanfordi* of Baluchistan, they are stated to come still closer to those of the American genus.

The exchange of plants between botanical gardens in various parts of the world is well known to have a considerable influence upon the geographical distribution of invertebrate animals. A classical example of this is the occurrence, first made known in 1880, of the fresh-water medusa, *Limnocodium sowerbyi*, in the *Victoria regia* tanks of the Royal Botanical Society in Regent's Park. In 1892 a remarkable fresh-water Oligochæte was discovered by Beddard in the same situation, and named by him *Branchiura sowerbyi*, one of its most interesting features being the possession of branchial appendages on the hinder part of the body. Otherwise the worm closely resembles the common European Tubifex. Branchiura has since been found in India, which is now believed to be its native habitat. It has also appeared in several places in Europe, and in a recently published memoir (*Zeitschrift für wissenschaftliche Zoologie*, Bd. cvii., p. 199) Friedrich Keyl makes some contributions to our knowledge of the anatomy of this remarkable worm, and summarises our knowledge of its distribution. It occurs in large numbers in the Victoria Regia house at Göttingen, and has been found in similar situations at Hamburg, Frankfurt a.M. and Dublin, while in the mild climate of Tournon, in the south of France, it has naturalised itself in the Rhone. Such facts as these clearly demonstrate the necessity of a thorough investigation of the terrestrial invertebrate fauna of the earth before the problems of geographical distribution have become more seriously complicated by human agency.

J. van Baren, in a paper published, with a German summary, by E. J. Brill, of Leyden, emphasises the existence of an older and a younger series of dunes, separated by a peat layer, on the northern part of the coast of Holland, and attributes the break between them to an elevation of the land. Subsidence in the Christian era has given us the outlying islands and the straight west coast of the country, on which marine denudation is at work.

The Canadian Department of Mines has issued the first Bulletin of the Victoria Memorial Museum in Ottawa, an institution which, in its new and handsome building, was obviously fated to have a journal of its own. Palæontology is naturally prominent, since the museum is under the care of the Geological Survey; but it may be hoped that this connection will lead to the establishment of a natural history survey for the Dominion, based on the explorations which are due to the energetic geological branch.

Dr. G. Linck's *Fortschritte der Mineralogie Kristallographie, und Petrographie*, which is the organ of the German Mineralogical Society, continues to justify its existence by the publication of authoritative essays on the progress of the sciences concerned. In vol. iii. for 1913 (price 10 marks) R. Marc discusses the mineralogical significance of the chemistry of colloids, and F. Rinne has an important paper, with a bibliography, on the decomposition of zeolites.

Mr. S. Fujiwhara has recently published an important memoir on the abnormal propagation of sound-waves in the atmosphere (Bull. of the Centr. Meteor. Obs. of Japan, vol. ii., pp. 1–143). The observations on which his work is based are chiefly those of the sound-waves due to the eruptions of Asama (Central Japan) from 1909 to 1912 (see Nature, vol. lxxxix., pp. 487–8). The principal facts to be explained are the great extension of the region of audibility in a special direction, as a rule easterly, from the source of sound, the division of the sound-area into two parts, with an intervening silent region, and the repetition of the sounds with intervals of a few seconds in certain districts. Mr. Fujiwhara's investigation, which is mainly mathematical, leads him to the conclusion that variations of the wind-velocity are chiefly responsible for the anomalous propagation of the sound-waves. He shows that, when the eruptions occur under normal weather conditions, with the velocity of the wind increasing with the height above the ground, then the anti-trade winds and monsoons would assist the easterly propagation of the sound-waves, and there would be no silent regions and no repetition of the sound. But if, as one example, the velocity of the wind should increase with the height up to a certain altitude and then decrease, a silent region should exist within certain limits, and the sound should be heard twice or thrice in others owing to the sound-rays following different paths from the source to the multiple-sound area.

In *Science Progress* for January Sir Oliver Lodge's presidential address to the British Association is discussed from two points of view by Dr. F. C. S Schiller ("The Logic of Science"), and by Mr. H. S. Shelton ("The Philosophy of Science"). Dr. F. W. Mott's third Chadwick lecture on the influence of nutrition and of education in mental development occupies some twenty pages, and Prof. Priestley publishes a second instalment of his article on enzymes as synthetic agents. One of the most interesting general articles is that contributed by Dr. E. Halford Ross on recent advances in our knowledge of syphilis, in which an account is given of the results obtained in the course of the McFadden researches at the Lister Institute; the complete cycle of development of the sexual and asexual elements of the *Lymphocytozoon pallidum*, which is held to be responsible for the disease, is described and illustrated. One of the most important results established is the occurrence in nature of syphilis in the rabbit and other lower animals.

For some years past the British Fire Prevention Committee has been directing attention to the question of the danger of celluloid, more particularly in connection with the kinematograph film trade. A special report, having the title, "Celluloid Dangers with Some Suggestions," has been compiled on behalf of the committee, and was recently laid before the Celluloid Committee of the Home Office, which has adopted many of its suggestions. The report is, however, largely intended for the guidance of local authorities, with the view of showing what appears to be technically possible, so that the authorities may be assisted in their administration and guided in introducing bylaws to minimise the dangers. The report, which is illustrated and supplemented with tables, is divided into two parts; the first deals with the dangers of celluloid, including films, the various uses to which celluloid is put, and the large number of fires in which it has been a feature; the second part deals with the methods of extinguishing celluloid fires, and suggests possible safeguards. The report is obtainable from the committee's offices, 8 Waterloo Place, Pall Mall, S.W.

On several previous occasions attention has been directed in these columns to the Bulletin of the Calcutta Mathematical Society, not so much on account of the original papers published in it as because it contains notes, reviews, and short notices of a miscellaneous and personal character attempting to chronicle the main events which are passing in the mathematical world. We have now received vol. i., No. 4, January, 1913 the date of receipt at the offices of Nature being November 8, 1913. It possesses all these excellent features in a similar degree to its predecessors, but it will be found that all the "Notes and News" refer to the year 1909. Information of a somewhat similar kind is published regularly in the Bulletin of the American Mathematical Society, but here, however, the activity and energy of American and German mathematicians quite throws British interests into the shade. Neither the Proceedings of the London Mathematical Society nor the *Mathematical Gazette* attempts anything of this kind, both being published in the interests of writers rather than of readers. It is surely desirable that some further attempt should be made to keep both the mathematicians and the non-mathematicians of Greater Britain posted up in the events that are taking place in the mathematical world.

We have received a copy of a paper on an electrical measuring machine read before the Institution of Mechanical Engineers in April last, by Dr. P. E. Shaw. The machine is intended for the accurate measurement of length gauges with plane or spherical ends, and makes use of the principle of electrical touch, that is, contact with the end surfaces is determined when a telephone circuit is completed thereby. End gauges may be compared with line standards, and comparative readings can be relied on to 1/10,000 of a millimetre. With a measuring machine of this high order of accuracy it is possible to show that some of the end gauges at present in use in engineering practice have errors amounting to 15/10,000 of a millimetre. It appears that the gauges turned out by Johansson, of Sweden, and by some of the American machinists are so accurate as to demand the best available measuring appliances to detect their errors. The machine has been installed at the National Physical Laboratory.

The December issue of the Journal of the Franklin Institute contains, among other articles, a paper by Mr. F. W. Peek, jun., dealing with the "dielectric circuit" from the view-point of high-voltage engineering. Mr. Peek devotes most space to transmission lines, and points out that air is the principal insulation, the line insulation being used for mechanical support. The dielectric circuit was not until recently understood, but it is now known that breakdown of insulation occurs when this is too much stressed, *i.e.* when the dielectric flux is too dense. Gaseous and liquid insulators, broadly speaking, behave in the same manner. It has been observed that the surface flux density, or the gradient at which visual corona starts or breakdown occurs, is higher for small conductors than for large ones—that is, air round small conductors has an apparently greater strength than around large ones. Investigation, however, has shown that the following explanation is probably correct. The strength of the air is constant, and is equal to 30 kilovolts per cm., but energy is necessary to start rupture. Therefore rupture cannot start at the surface, but only after the surface gradient has been increased sufficiently to store the rupturing energy between the conductor surface and a distance of $0{\cdot}301\sqrt{r}$ cm. away in air, where r is the radius of the conductor. The author deals with the grading of cables, the methods of breakdown in solid insulators, &c., and shows how, by the production of water vapour, the needle gap method of measuring voltages may give readings anything up to 30 per cent. too high when voltages are being measured. The use of spheres is recommended.

The Journal of the Royal Society of Arts for December 5, 1913, contains a paper on perfumery, read before the society by Mr. J. C. Umney. The contribution consists largely of an account of the natural odoriferous oils and the various synthetic products used in perfumes. It is pointed out that whilst Rimmel in 1860 classified the essential oils chiefly according to their source—animal, floral, herbal, and so on—a classification based upon the main chemical constituents of the oils could now be adopted. Thus the geranium oils, citronella oil, and otto of rose, all containing the alcohol geraniol, are distinguished as the geraniol group; the linalol group includes lavender, neroli, and bergamot oils; and the eugenol group contains the oils of clove, pimento, and bay. Mention is made of the fact that there is a systematic manufacture of bodies designed solely for the purpose of adulterating perfumes; the adulterants include glyceryl acetates, ethyl citrate, laurate, succinate, and phthalate, and methyl phthalate. Some stress is laid on the bactericidal properties possessed by certain of the essential oils; for example, origanum oil, the most effective of those referred to, is stated to have a "carbolic acid coefficient" of 25·76, attributable to the high proportion of carvacrol it contains. Other examples of such coefficients are given, ranging down to 4·94 for lavender oil and 1·0 for oil of cade. It is stated that the protective power of lemongrass in keeping off the tsetse-fly has led to the cultivation of the plant and the distillation of lemongrass oil in Uganda.

With reference to Dr. Rosenhain's letter in Nature of January 8, upon a new method of etching steels, Dr. C. H. Desch directs attention to papers by Prof. F. Giolitti (*Gazz. chem. ital.*, 1906, vol. xxxvi., ii., p. 142; 1908, vol. xxxviii., ii., p. 352) upon the use of the electro-chemical deposition of copper in the etching of bronzes. Prof. Giolitti's work does not, however, anticipate the use of the new reagent for steel described by Dr. Rosenhain, and particularly for the study of phosphorus distribution, although it seems probable that the banded structure of phosphoritic steel is a direct consequence of core formation during the first solidification of the steel.

A paper dealing with commercial tests of internal-combustion engines was read at the Institution of Mechanical Engineers on Friday last, January 16, by Mr. W. A. Tookey. In such tests, it is usually not possible to obtain measurements other than the gas consumed or liquid fuel used, indicator diagrams, bore and stroke of the cylinder, and the valve settings. From this information, advice has to be tendered regarding possible improvements in the engine, and Mr. Tookey advocates the use of a factor obtained by dividing the mean pressure, as shown by the indicator diagram, by the mixture strength. The mixture strength is defined as the calorific value, in British thermal units, of one cubic foot of stuff in the effective cylinder volume, and may be calculated with good approximation from the cylinder dimensions and the information to be obtained from ordinary and light-spring indicator diagrams. The author uses the index 1·3 for the compression curve, and has found his factor to be of great service in dealing with more than 700 gas engines which he has tested during the last few years on behalf of London gas companies.

The Morning Post has published an exhaustive list of congresses of learned societies and other bodies to be held during the present year, and some which have been announced for future years. The list is arranged conveniently on a large card for hanging on the wall, and should prove very valuable as a source of reference to forthcoming events.

Messrs. J. and A. Churchill write to point out that the price of "Who's Who in Science," which was briefly noticed in last week's Nature (p. 553), was incorrectly given as 2s., whereas it is 10s. net.

OUR ASTRONOMICAL COLUMN.

Spectra of Stars near the North Pole.—In the Harvard College Observatory Circular, No. 180, we are informed that in the preparation of the revised Harvard Catalogue Miss Cannon has now classified the spectra of 110,000 stars covering more than one-half of the sky. As Prof. E. C. Pickering has received numerous requests for the spectra of stars near the pole the present circular contains a special list, prepared by Miss Cannon, of stars within 10° of it. All stars are included which have a magnitude in the Durchmusterung of 8·3 or brighter, and the table consists of three columns giving the number in the Durchmusterung, the photometric or Durchmusterung magnitude, and the type of spectrum. The number of stars included in this list is 825.

Change in Lunar Crater Eimmart.—Prof. W. H. Pickering, writing from the Harvard Astronomical Station at Mandeville, in Jamaica, records, in a recent number of the *Astronomische Nachrichten*, No. 4704, a change in the lunar crater Eimmart which has lately taken place. The change in appearance, he states, is so noticeable that he considers it desirable to direct the attention of astronomers, and especially of selenographers, to it at once, as it is the most marked non-periodic change that he has ever observed. The crater lies on the north-western border of the Mare Crisium in long. 295°, lat. +24°, and is about twenty-five miles in diameter. The general nature of the change is shown in the two illustrations which accompany his communication. While formerly, at each lunation, the crater apparently gradually filled up and overflowed with a white material, the source of which was at a point at the foot of the northern interior slope, this change no longer occurs. The last regular eruption observed, if, as Prof. Pickering states, it is considered proper to use this term, occurred in January of last year. Observations in February and March of last year indicated a reduction in activity, while in April and May of the same year the activity was scarcely noticeable. The point Prof. Pickering desires to be settled is this:—When the moon is just past first quarter, Eimmart was distinctly brighter than any area of similar size between it and the limb. This is not the case at present, and the question is, Will this condition ever occur again? Details of his observations are given in his paper, and he indicates other differences in appearance of this crater, in addition to that above mentioned.

The Madrid Observatory Annual for 1914.—The first portion of this annual is continued on the same lines as in previous issues, and consists of the different forms of calendars, ephemerides of the members of the solar system, and useful astronomical tables and the explanations of them. These occupy about 200 pages. Then follows a series of sections relative to other astronomical matters. The first is devoted to practical rules for the installation of an equatorial and the study of the correction of the objective. An account is next given of the proceedings of the International Solar Union meetings at Bonn. The observations of solar prominences made during the years 1907–12 are next studied and described in some detail, succeeded by the observations of spots, prominences, flocculi, and radiation made for the first two phenomena during the year 1912, and for the last two for the twelve months ending September and August, 1913, respectively. These take up about another 200 pages. The last portion is devoted to the meteorological observations made during the year 1912, with an annual summary, and occupies about 150 pages.

MEMORIAL TABLET TO LORD LISTER.

A TABLET in memory of the late Lord Lister was unveiled by Lord Rayleigh at King's College, London, on January 14. The unveiling was preceded by an impressive ceremony in the chapel, among those present being Dr. Herringham (Vice-Chancellor of the University), Sir Rickman Godlee (president of the Royal College of Surgeons), Sir William Crookes (president of the Royal Society), Sir Henry Miers (principal of the University), Dr. Caldecott (Dean of King's College), Sir St. Clair Thomson, Prof. Halliburton, Prof. J. M. Thomson, Sir David Ferrier, Sir John Rose Bradford, and Mr. and Mrs. J. J. Lister.

Lord Rayleigh expressed his pleasure at thus being able to pay a small tribute to the memory of Lister, under whom he had been privileged to serve for a time at the Royal Society. It is now a commonplace that by his advances in surgery he had saved more lives than Napoleon had destroyed. Lister, in addition to his extreme modesty, was always ready to acknowledge obligations, and delighted his French colleagues by his generous insistence that his work was a natural development of that of Pasteur.

Lord Rayleigh was followed by the Vice-Chancellor of the University, Dr. Herringham, who pointed out that Lord Lister, at the invitation of King's College Hospital, gave up the chair he held at Edinburgh. Dr. Herringham expressed the wish that such translations were more common, for they conferred honour not only on those translated, but also on the institutions from which they emanated.

Sir Henry Miers, Prof. Halliburton, and Dr. Caldecott also spoke briefly.

The tablet, which has been erected in the corridor outside the chapel, bears the inscription:—

"In affectionate and respectful memory of Joseph, Baron Lister, F.R.S., O.M., Professor of Clinical Surgery in King's College from 1877–1892, and for many years consulting surgeon to the King's College Hospital, Member of the Council and Life Governor of the College, this tablet is erected. His name will be handed down to posterity as the founder of antiseptic surgery, one of the greatest discoveries in history and a source of inestimable benefit to mankind."

THE "DAVON" MICRO-TELESCOPE.

MESSRS. DAVIDSON AND CO. have recently produced a "micro-telescope," an instrument which is essentially a microscope of ordinary construction carrying a short focus telescope objective and tube below the stage. It may here be remarked that the ordinary terrestrial telescope with erecting eyepiece is nothing more than an object-glass, and a microscope, for an erecting eyepiece is nothing more than a microscope of low power. This is at times of great use in the workshop or laboratory, where a low-power reading microscope may be wanted in a hurry, but it is not everyone who remembers that a pocket telescope contains within itself this instrument also. While, therefore, the micro-telescope and the ordinary telescope with erecting eyepiece have the same sequence and function of lenses, and each gives an erect image, yet in proportions and practically the micro-telescope is a very different thing. The triple objective in the micro-telescope, though of only $5\frac{1}{2}$ in. focal length, instead of the usual 8 or 9 in., successfully withstood the following severe test. At a distance of a rod, pole, or perch and a half, and a yard and a quarter (which works out as 342 in.), a Bellows French Dictionary could be read perfectly and with a $\frac{2}{3}$ in. microscope objective a circle of $3\frac{1}{8}$ in. in diameter could be seen at once all in focus and with no sign of colour. As a more severe test a number of groups of artificial double stars, made by small needle-holes in tin foil, of which the closest group were all separated by 1/100 in. centre to centre, were set up at the same distance, and all were clearly double stars as seen in the micro-telescope, clear, sharp, and without colour, but with the first diffraction ring clearly showing. These stars subtended centre to centre an angle of almost exactly 6″ of arc, and as the needle-holes were not geometrical points, this test shows that the object-glass was up to the optical limit imposed by the size of the wave-length of light.

Some crumbs were then placed on the floor at a distance of four yards, and strongly illuminated, and the microscope with a 1 in. object-glass focussed on the crumbs. Presently some mice came out, and made themselves at home with the crumbs. The mice could be examined at this distance without their being aware of it so well that individual hairs were easily visible and about half a mouse was in the field of view. In point of size it appeared about the same as a beaver within a foot or two. The magnifying power was measured and found to be 42.

A plane mirror silvered on the front face is provided to be clipped on in front of the telescope objective, so that objects may be examined without tilting the micro-telescope to an inconvenient angle. This has the two motions necessary to bring an object into the field of view. The double-star test showed that the mirror interfered slightly with the perfection of the image, but not to such an extent as to be noticeable except with so severe a test. A more serious difficulty, however, is that of finding an object when seen in this way. It would be easy enough with the moon, for instance, and perhaps with a bright planet like Venus or Jupiter, but it would probably require some practice to find such a star as β Cygni.

A further attachment is provided by means of which the microscope tube is replaced by a camera so that either microscope photographs may be obtained if the telescope element is replaced by a substage illuminator, or if the telescope fitting is in its place the combination enables telephotographs to be taken; some of these submitted by the makers show that in this domain also excellent results are possible.

Altogether the new instrument is one with many possibilities, and it will appeal to people with widely different interests.

C. V. Boys.

A NEW INCANDESCENT ELECTRIC LAMP.

A NEW incandescent electric lamp with an efficiency of about 0·5 watt per candle-power has just been placed on the market by several of the leading manufacturers in this country. It is only a few years since the tungsten filament lamp, with an efficiency of between 1 and $1\frac{1}{4}$ watts per candle-power appeared, to displace the carbon filament lamp the efficiency of which was between 3 and 4 watts per candle-power. In the case of the "half-watt" lamp, however, there is no change in the material of the filament. This is still tungsten.

Hitherto the tungsten lamp has been run at a temperature of about 2100° C., for although this is roughly 800° C. below the melting point of the metal, an effort to obtain a higher efficiency by employing a higher working temperature produced a deposit of metallic tungsten on the bulb. Analysis of the residual gases left in the bulb after exhaustion showed that the only one which could cause this effect was water vapour, and a cyclic process was traced. The water vapour attacked the heated filament, producing a volatile oxide of tungsten and atomic hydrogen; the oxide which became deposited on the bulb was again reduced by the hydrogen, leaving metallic tungsten and forming water vapour, which again attacked the filament. Even when practically every trace of water vapour was removed, however, a certain blackening of the bulb still occurred, and this was eventually found to be occasioned by evaporation of the metal. To overcome this, nitrogen or some other inert gas is introduced into the bulb at about atmospheric pressure, and this is one of the features of the new lamp.

This, however, introduced another effect. The filament is more rapidly cooled by the convection currents induced in the gas, and in consequence more energy is required to maintain the temperature. With filaments of large diameter this is of less relative importance, but with filaments of the usual size the loss was found actually to reduce the efficiency in spite of the higher temperature, as the small filaments are cooled relatively more rapidly by the convection currents. As a result the high-temperature half-watt lamps are only made in large sizes from 600 c.p. upwards—and in order to diminish this cooling effect the filaments are constructed in the form of a helix of very small pitch. Last week's issue (January 15) of *Electrical Engineering* is devoted largely to the new lamp, and the opinions of leading central station engineers in various parts of the country upon it are quoted.

THE ASSOCIATION OF PUBLIC SCHOOL SCIENCE MASTERS.

THE annual meeting of the Association of Public School Science Masters was held at the Imperial College of Science and Technology on January 13–14. The president, Prof. H. B. Baker, F.R.S., in his address, extracts from which are given separately in this issue, regretted that so few science masters were engaged in research, and suggested that the interest of boys would be stimulated by the thought that such work was being carried out in the laboratory attached to their own school. Mr. C. E. Ashford (Dartmouth), in seconding a vote of thanks, disagreed with this view, and, speaking as a headmaster, maintained that it was of greater importance for a schoolmaster to spend his spare time in the playing fields getting to know his boys than it was for him to be undertaking research in the laboratory.

On the afternoon of the first day an interesting demonstration of the application of the gyroscope to mono-rail traction was given by his Excellency Monsieur Pierre Schilowsky, who exhibited a model of a new and improved form of the appliance he has recently invented. Mr. H. O. Hale (Oundle) read a paper upon agricultural experiments in public schools; he urged that agricultural research was well within the capacity of the average boy, and was more real than most of the "mock research" carried out in the chemical laboratories. The idea is excellent, and many of the results obtained were of considerable interest; it was, however, rather disappointing to find during the course of the subsequent discussion that much of the work, and even of the observations, were made for, instead of by, the boys themselves: the impression left being that, although the "experiments" afforded the foundation of a useful future hobby, they did not, under the conditions which prevail at present, provide a basis for a scientific education.

Wednesday morning was occupied by a discussion upon the "Present Condition of Science Teaching in Public Schools," which was opened by Dr. E. H. Tripp (Bedford) and Mr. J. R. Eccles (Holt). Dr. Tripp deplored that the pamphlet published by the Board of Education in 1906 referred to a few only of the public schools, and that its aim was to state facts rather than to make suggestions; he urged the need of a fresh report which should not only state the conditions under which science was taught in all schools represented by the Headmasters' Conference, but should contain expressions of opinion from external authorities, *e.g.* university teachers and employers of ex-public school boys engaged in scientific occupations. He maintained that the chief drawbacks to progress in science teaching were (*a*) the undue preponderance of literary headmasters; (*b*) the conservative influence of the older universities; and (*c*) the evils of the present examination system. The address was chiefly of a destructive nature, and the subsequent discussion, although well maintained, was less fruitful in producing constructive proposals than in pointing out the defects of the existing system.

The discussion opened by Mr. D. Rintoul (Clifton) upon the "Place of Acoustics in a School Course of Physics," fell rather flat, owing, probably, to the unanimity of the members in considering that, whilst acoustics afforded a valuable introduction to the study of the wave theory, the difficulty in devising suitable laboratory exercises made it educationally the least valuable branch of physics. The most useful suggestion was that made by Mr. G. F. Daniell, that the determination of the velocity of sound in various gases might be introduced into the ordinary work of the chemical laboratory; he urged that if this were done something would have been accomplished towards breaking down the watertight compartment which too often separated chemistry from physics.

Mr. H. A. Wootton (Westminster) read a paper upon the "Relative Educational Value of Physics, Chemistry, and Biology," maintaining that chemistry, when properly taught, was the most useful subject. During the discussion which followed the paper it was pointed out that it was impossible to teach chemistry without also giving considerable instruction in physics, and several speakers urged that organic chemistry should be commenced at an earlier age than is at present the practice.

At the business meeting, Sir William Osler, F.R.S., Regius professor of medicine at Oxford, was elected president of the association for 1915.

SCIENCE IN THE PUBLIC SCHOOLS.[1]

ONE of the chief difficulties which besets a science master is that few of his colleagues will have sympathy with his work. There are some, but I am afraid not very many, classical scholars who have some knowledge of studies which are so different from their own, but, too often, there is actual hostility on their part to science subjects, and since the first years of a boy's life are usually under the charge of a classical master, there is often instilled into his mind a contempt for the subjects which may be useful to him in his after life.

In most schools which I know, there is a system of selection of the boys by which those of the best ability are induced to continue on the classical side. It is, with comparatively few exceptions, only the weaker boys, or those whose ability has escaped notice, who are allowed to make science their chief study. But, in spite of this fact, which is known to most schoolmasters, how often is it triumphantly declared that a boy who has been educated on the classical side of a school is superior to one brought up on the science side? I wish, for just one year, that the science

[1] From the presidential address delivered to the Association of Public School Science Masters on January 13 by Prof. H. B. Baker, F.R.S.

masters could have their pick of the boys in all the public schools. I warrant that that statement would never be made again. I have often urged on head-masters the advisability of allowing more boys of pronounced ability to do more science at school. Over and over again I have been told that boys ought not to specialise at school, as if the sixteen or seventeen hours a week spent at classics was not more specialisation than the ten or twelve hours' science which was recommended. One might expect that, in these more enlightened days, more parents would rebel against a mediæval system of education, but as a rule a parent does what he is told.

He lets the boy specialise in classics, although his future career may require a scientific training. In a very large number of cases men have come to me, both at the Imperial College and at Oxford, who want to be doctors, engineers, and the like, who have done little or no science, even when the schools from which they came were exceedingly well equipped for science teaching. In nearly every case the reason was the same, the parent had consulted the classical master, and taking what he thought was an expert opinion had decided to let his boy spend his time on classics. I say "spend," not "waste," for it really is rather a pleasant thing to have a knowledge of Latin and Greek. It is pleasant, and even sometimes useful, to know the derivation of words, but since, if we may accept an estimate quoted by Emerson, five-eighths of the words in English are not derived, either directly or indirectly, from the classical languages, the argument would be much stronger in favour of boys learning Anglo-Saxon. Latin and Greek ought to be regarded as luxuries, not as essentials, in education. It is to be hoped that in the near future there will be an organised revolt of British parents, and that they will demand that their boys shall be taught what will be of use to them afterwards, modern languages, including English, science, and mathematics. I suppose it is too much to hope that the new Education Bill, since apparently it is to touch the public schools, will help in making the education given in them more practical, doing, in fact, what classical masters will not, and science masters and parents cannot do.

The number of clever boys in any class is quite small. By cleverness I do not mean the capacity for learning; real cleverness, I take it, is the almost automatic power of picking out the essentials from a mass of inessentials, getting, in fact, to the root of the matter at once. Now it is too frequently the boy with a good memory, and that alone, who is picked out of the elementary school and sent on his upward way as something out of the common. Such boys have, of course, their proper and useful place in the scheme of things, but they are not going to do great things in the world. It is the other kind of cleverness that the country needs at the top, but there must be more than this cleverness even; the boy must have grit besides. He must be able to struggle and fight his way up, and, for this reason, let us earnestly hope that all the difficulties will not be cleared away. It is a ladder we want, not a moving staircase.

It is more and more common for the public-school boy to choose an engineering career, and it will be well for science masters to guard parents against sending boys into works, say at the age of sixteen, with an insufficient mathematical and scientific basis. Many engineers, and successful men, too, have recommended this course, saying the boys can pick up their mathematics and science for themselves.

The best course for an aspiring engineer is that he should have two years of good practical mathematics and science in properly equipped engineering laboratories, and when he gets into works he will have the seeing and understanding eye. The last two years of his school life should be mainly devoted to mathematics, chemistry, physics, and both French and German, of which languages he should have a speaking as well as a reading knowledge.

I wish it were possible to include among possible careers for science boys the home Civil and the Indian Civil Services, for it is undoubtedly the case that those services would benefit greatly by such inclusion. The regulations at present in force, however, give too great an advantage to the classical boy. Out of the 6000 marks which it is possible for a candidate to aim at no fewer than 4400 are assigned to the subjects ordinarily included in a classical training. These marks are given for Latin, Greek, Roman and Greek history, logic and psychology, and mental and moral philosophy. Against these a science man can, as a rule, offer only lower mathematics and two science subjects, aggregating two thousand marks less. It is true that he might learn two more science subjects up to the not very high standard required, and that would add another 1200 to his possible marks. If he did so, however, and failed to get in, he would not be fit for any scientific career, except perhaps an inferior teaching post. The standard of the subjects in this examination is too low for it to be of use to him in any way, except it be supplemented in one subject by two years more advanced study. If science men are desired for these two great public services a much higher standard in at most two science subjects should be demanded, with a corresponding increase in the total marks attainable.

For those boys who have made physics their chief study at school and at college, there are fewer careers open than to those who have specialised in other branches of science. But I understand that aviation is going to bring this branch of science into prominent and practical usefulness. If one thinks also of the number of meteorologists in this country and its dependencies, it is obvious that here is an outlet for the physicist. The main bulk, however, of physics men become teachers.

To the chemist many avenues are open, and this is largely due to the awakening of the manufacturer to the usefulness of research work in all directions. I need not again recall to you the contrast of the German works and our own, but it would certainly be no exaggeration to say that, even now, for every industrial research chemist in this country there are twenty in Germany. However, there is no doubt that in the last five years the number of works chemists, of the research type, has enormously increased. It is for us who teach the boys and men to see that this most healthy movement, which is of Imperial importance, is not checked by the poor quality of the men sent into the works. Unless they are men with a natural aptitude for investigation and have been properly imbued with the research spirit, both at school and at college, it will be nothing less than a great misfortune for the country.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. G. R. Mines, of Sidney Sussex College, has accepted a temporary post as demonstrator of physiology in the University of Toronto. He will return to Cambridge about the middle of May.

Announcement is made that part i. of the examination for the diploma in psychological medicine will begin on Tuesday, June 2, and part ii. on Tuesday, March 31. The examination for part i. will be held in Cambridge; that for part ii. will be held in London.

The acting director of the observatory gives notice that between the hours of 8 and 10.30 p.m. on fine and clear Saturday evenings during the Lent full term celestial objects will be shown through the Northumberland equatorial to members of the University.

THE University of London Graduates' Association has issued a pamphlet detailing the objections of the association to the scheme proposed by the Royal Commission on University Education in London. The price of the pamphlet is one penny, and copies may be obtained from Mr. A. S. E. Ackermann, honorary secretary of the association, 25 Victoria Street, Westminster, S.W.

WE record with much satisfaction Sir Hildred Carlile's gift of 105,000*l.* to the Bedford College Endowment Fund. Writing to Lord Haldane, the president of the Endowment Fund, Sir Hildred Carlile asks that the donation may be considered as a memorial to his mother, and we agree with the Lord Chancellor that no nobler memorial to Mrs. Edward Carlile could have been established. The donation is believed to be the largest individual gift that has ever been made for the education of women in this country. Beyond the stipulation that no part of the money is to be used for building, no condition whatever is attached to the gift, which will go a long way towards establishing the college on a firm financial basis.

THE movement for the establishment of a national university in Washington on the plan endorsed by the National Association of State Universities, is, says *Science*, taking form, and President James, of the University of Illinois, has, it is understood, commenced the preparation of a Bill soon to be submitted to President Wilson for his approval, and afterwards to be introduced in both houses of Congress. The Bill provides for a preliminary grant of 100,000*l.* toward the establishment of a university to be under the control of a board appointed by the President of the United States. It will propose an advisory board made up of one delegate from each State to frame the policy of the institution.

WITH the view of establishing a memorial to the late Lord Avebury, a small committee has been formed under the chairmanship of the governor of the Bank of England, with representatives from the Royal Society, the University of London, the London Chamber of Commerce, and the Clearing Bankers. This committee has agreed that there can be no more suitable memorial than the foundation at the University of London of scholarships in economics, and in some other branch of scientific research in which Lord Avebury was especially interested. The minimum fund to establish such scholarships should, the committee states, amount to at least 5000*l.*, but a still larger sum is desirable; and if a sufficient sum were raised a professorship or readership might be founded. Subscriptions have been promised amounting to nearly 3000*l.* Subscriptions should be paid in to the Lord Avebury Memorial Fund at the Bank of England.

IN concluding an interesting article on the education of the German artisan, appearing in *Engineering* for January 9 and 16, Mr. H. S. Rowell says that the outstanding difference between England and Germany in all things is represented by the opposites systemism and individualism. The one is the result of despotic government and widespread education; the other is traceable to political precocity and indifference to education for its own sake. Both these opposites have virtues and faults, and no one is wise enough to say how far they should be blended, how far the individual must sink before the system. But one thing is certain in comparing the two countries, and that is the difference in the attitude towards science. The English, working and employing classes alike, are still sadly lacking in this respect. For opprobrium they use the words "theoretical" and "scientific"; for praise "practical." It is seldom realised that science is neither purely practical nor purely theoretical, but simply truth and good sense organised.

THE question of the proper utilisation of our great national museums is one that is nowadays engaging increasing attention. Partly as the result of a debate which took place in the House of Lords some time ago, guide demonstrators have been, or are being, appointed to museums and botanic gardens. The London County Council has contributed largely towards bringing the national treasures more closely before the children in the schools, the system adopted being to familiarise the pupils with the exhibits by means of the teachers. Accordingly lectures are given from time to time in various places of national interest for the purpose of acquainting teachers with the organisation of the various national exhibits so that their pupils can derive the maximum benefit on occasions of educational visits. In furtherance of this object, Lord Sudeley, who has played a prominent part in educating public opinion as to the need for the appointment of guide demonstrators at the museums, will address London teachers on the public utility of museums, picture galleries, &c., at the Birkbeck College, Chancery Lane, on Saturday, January 31, at 11 a.m., when the chairman of the London County Council Education Committee, Mr. John W. Gilbert, will preside. Tickets of admission to the meeting can be obtained from the education officer of the London County Council, Education Offices, Victoria Embankment.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, December 16, 1913.—Dr. J. H. Pollok in the chair. Prof. K. **Yendo**: Cultivation of sea-weeds in Japan. Sea-weeds are extensively used in Japan as food, glue, and manure. The annual amount of production is estimated at about 800,000*l.*, of which 300,000*l.* worth is exported, chiefly to China. The most important point in cultivation is to give the plant a suitable ground for attachment. Various factors, such as depth, light, salinity, temperature, nature of substratum, movement of water, &c., have great influence in limiting the growth of sea-weeds in a certain locality. The author explains these factors with reference to plant-life in the sea, and describes the modes of cultivation in Japan.—Dr. G. H. **Pethybridge**: Further observations on *Phytophthora erythroseptica*, Pethyb., and on the disease produced by it in the potato plant. The peculiar mode of development of the sexual organs (intra-antheridial growth of the oogonial incept) described for this species by the author in a former paper, and shown by him to occur also in *P. infestans* and *P. phaseoli*, has been found in *P. parasitica*, Dast., and *P. colocasiae*, Racib., by Dastur, and by Butler and Kulkarni respectively. In the present paper the production of zoospores and of germ tubes by the conidia and the mode of germination of the oospores is described for *P. erythroseptica*. The inner thickened part of the oospore wall is composed of cellulose, and previous to germination becomes dissolved, so that it thus appears to serve not only as a protective covering for the spore, but also as a store of reserve carbohydrate. The fungus with its reproductive organs has now been found in all the underground portions of the potato plant. It is the cause not only of a specific rot of the tubers, but of a disease of the plant as a whole, of the "wilt" type, the outward symptoms of disease being rather similar to those produced by *Bacillus melanogenes*, Pethyb. and Murphy.—Prof. H. H. **Dixon**: Note on the spread of morbid changes through plants from branches killed by heat. Experiments are described showing the possibility of washing out the poisonous materials liberated in the water tracts of branches killed by heat, and thus removing the contamination from the water supply of the leaves above. The withering of the leaves on a killed branch may in this way be long postponed. It is also possible to wash back the contaminating substances from the dead branch into other branches, when it is found that the leaves on the otherwise uninjured branches wither. Both these experiments show that it is not allowable to assign the withering to a failure in the water supply brought about directly by the death of the cells of the heated branch.—W. R. G. **Atkins**: Oxydases and their inhibitors in plant tissues. Part iii., The localisation of oxydases and catalase in some marine algæ. Catalase was found in all algæ tested. Out of a total of twenty-nine, only one alga gave the direct oxydase reaction, while six gave the indirect with guaiacum. In two cases only was a colour produced with α-naphthol. Prof. T. **Johnson**: *Bothrodendron kiltorkense*, Haughton, sp.: its cone and Stigmarian stage. The specimen described supplies conclusive evidence that the Stigmarias found in the Kiltorcan quarry are the underground root-carrying rootstocks of Bothrodendron. In one specimen organic continuity is shown between the aërial stem with typical leaf-scars and Stigmaria with appendages, a horizontal line of demarcation indicating the ground level. The paper also contains a description of a fertile shoot ending by repeated forking in four tips of which three are stalked cones, 3×5 cm. in extent, the fourth being sterile.

Paris.

Academy of Sciences, January 12.—M. P. Appell in the chair.—Maurice **Hamy**: The use of the objective prism in the determination of radial velocities. An arrangement is described in which a spectrograph with a prism objective gives a determination of the motion of a star in the direction of the line of sight, by comparison with a terrestrial spectrum.—G. **Lippmann**: A method of regulating a telescope for autocollimation. A plate of silvered glass, on which a fine line has been traced with a diamond, is placed at an angle of 45° to the axis of the telescope. The slit is illuminated from a point on the axis of the telescope, and looked at by an eyepiece at the side of the instrument. When the axis is at right angles to the reflecting mercury surface the slit cannot be seen; the accuracy of the adjustment does not depend on the size of the slit, but only on the quality of the telescope itself.—Fred **Wallerant**: Rotatory power in biaxial crystals.—A. **Laveran**: *Trypanosoma soudanense* as the cause of *debab* of Algeria. The disease affecting dromedaries, and sometimes horses, in Algeria, and known as *debab*, is shown to be caused by *T. soudanense*, and has nothing in common with *T. evansi*.—M. **Vasseur** was elected a correspondant for the section of mechanics in succession to M. Gosselet, elected non-resident member.—M. **Gambier**: Curves of constant torsion.—Arnaud **Denjoy**: A property of certain functions.—Jules **Pál**: The transformations of functions the Fourier series of which converge.—Ph. **Frank** and G. **Pick**: Some measurements in functional space.—H. **Bohr** and E. **Landau**: The zeros of Riemann's $\zeta(s)$ function.—R. **Bricard**: A doubly decomposable movement.—A. **Tauleigne, F. Ducretet**, and E. **Roger**: The graphical registration of radio-telegrams. The apparatus described makes use of an electrolytic detector of a modified type in connection with a polarised relay. The instrument has given a good record of Eiffel Tower signals at Dijon, 275 kilometres from Paris, and experiments are being made at greater distances.—M. **Swyngedauw**: The resonance of the three harmonics of triphase alternators.—R. **Marcelin**: The expression of the velocities of transformation of physico-chemical systems as a function of the affinity.—J. **Canac** and E. **Tassilly**: The deposition of nickel upon aluminium. A special preliminary treatment of the aluminium is described, and nickel is then electro-deposited in a very coherent form. The nickel-plated aluminium does not change in moist air, and resists the action of dilute soda solutions, glacial acetic acid, or strong brine. R. **Goubau**: The melting point of arsenic. The melting point of arsenic was measured in a quartz bulb under pressure, and found to be 817° C.—José Rodriguez **Mourelo**: The phototrophy of inorganic systems. L. **Crussard**: Deflagrations in a steady state in conducting media.—Ed. **Chauvenet**: Two compounds of zirconium chloride with pyridine.—G. **Friedel**: The crystalline structures rendered evident by the diffraction of the Röntgen rays.—Michel **Longchambon**: The carbonate sedimentation and the genesis of the dolomites in the Pyrenees chain.—P. **Chaussé**: Researches on the pulverisation of tuberculous saliva and sputa by air currents. No particles of saliva or sputa are detached by contact with air moving with velocities under 30 metres per second; at higher velocity respirable particles are removed and can convey the infection.—R. **Argaud** and I. **Brault**: Lepra cells and plasma cells.—M. **Lécaillon**: The fecundity of *Colaspedima atra*.—Auguste **Lumière** and Jean **Chevrotier**: The resistance of the gonococcus to low temperatures. M. **Javillier**: A cause of error in the study of the biological action of some chemical elements; the presence of traces of zinc in glass. *Aspergillus niger* is very sensitive to the stimulating action of minute traces of zinc salts in its culture solutions. It is shown that sufficient zinc is given to culture fluids by Jena glass to mask entirely any effects due to added glucinum, or cadmium. Experiments carried out in quartz or Bohemian glass vessels give quite different results on the growth of moulds from experiments made in Jena glass vessels.—L. **Mengaud**: The Cretacian in the neighbourhood of Comillas, province of Santander.—O. **Mengel**: The Pliocene of Roussillon.—Louis **Gentil**: The structure of the plateau of Beni Mtir, central Morocco.—Albert **Brun**: The exhalation of Kilauea in 1910.

BOOKS RECEIVED.

Die Süsswasser-Flora Deutschlands, Oesterreichs und der Schweiz. Edited by Prof. A. Pascher. Heft 14. Pp. iv+222. (Jena: G. Fischer.) 5.60 marks.

Anuario del Observatorio de Madrid para 1914. Pp. 594. (Madrid.)

Comité International des Poids et Mesures. Procès-Verbaux des Séances. Deux. Série. Tome vii. Session de 1913. Pp. v+140. (Paris: Gauthier-Villars.)

Ueber die Erkenntnis a priori insbesondere in der Arithmetik. By N. Ach. I. Teil. Pp. 70. (Leipzig: Quelle und Meyer.) 2.25 marks.

Bienen und Wespen, ihre Lebensgewohnheiten und Bauten. By E. J. R. Scholz. Pp. viii+208. (Leipzig: Quelle und Meyer.) 1.80 marks.

Prinzipien der Erkenntnislehre. By Prof. E. v. Aster. Pp. viii+408. (Leipzig: Quelle und Meyer.) 7.80 marks.

Das Problem der Brütung. By Dr. J. Fischer. Pp. 155. (Leipzig: Quelle und Meyer.) 3.20 marks.

Das Nachsprechen von Sätzen in seiner Beziehung zur Begabung. By E. Gassmann and E. Schmidt.

Pp. 101. (Leipzig: Quelle und Meyer.) 3.25 marks.

Intelligenz und Wille. By Dr. E. Meumann. Zweite Auflage. Pp. viii+302. (Leipzig: Quelle und Meyer.) 4.60 marks.

Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. v., No. 3. A Preliminary Study of the Prehistoric Ruins of Nakum, Guatemala. A report of the Peabody Museum Expedition, 1909–10. By A. M. Tozzer. Pp. viii+143–201+plates. (Cambridge, Mass.)

The Chemistry of the Radio-Elements. By F. Soddy. Part ii., The Radio-Elements and the Periodic Law. Pp. 46. (London: Longmans and Co.) 2s. net.

Board of Agriculture and Fisheries. Fishery Investigations. Series i. Salmon and Fresh-water Fisheries. Vol. i. Pp. 126+plates. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4s.

Solid Geometry. By Prof. W. B. Ford. Edited by C. Ammerman and E. R. Hedrick. Pp. ix+215–321+xlix. (London: Macmillan and Co., Ltd.) 3s. 6d. net.

Definitions in Physics. By Prof. K. E. Guthe. Pp. ix+107. (London: Macmillan and Co., Ltd.) 3s. 6d. net.

Memoirs of the Geological Survey. Scotland, 82. The Geology of Central Ross-shire (Explanation of Sheet 82). By Dr. B. N. Peach and others. Pp. vi+114+viii plates; map (Sheet 82). (Edinburgh: H.M.S.O.; London: E. Stanford, Ltd.) 2s. 6d.

Calendario della Basilica Pontificia del Santissimo Rosario in Valle di Pompei, 1914. Pp. 272+112. (Valle di Pompei: B. Longo.)

Controlled Natural Selection and Value Marking. By J. C. Mottram. Pp. ix+130. (London: Longmans and Co.) 3s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 22.

ROYAL SOCIETY, at 4.30.—The Heat Production Associated with Muscular Work. (A Note on Prof. Macdonald's Paper, Proc. R.S., B, vol lxxxvii.): Dr. R. T. Glazebrook and D. W. Dye.—The Chemical Interpretation of some Mendelian Factors for Flower Colour: M. Wheldale and H. L. Bassett.—The Determination of the Minimum Lethal Dose of various Toxic Substances and its Relationship to the Body Weight in Warm-blooded Animals, together with considerations bearing on the Dosage of Drugs: Prof. G. Dreyer and Dr. E. W. A. Walker.—Experiments on the Restoration of Paralysed Muscles by means of Nerve Anastomosis Part ii., Anastomosis of the Nerves supplying Limb Muscles: Prof. R. Kennedy.—Variations in the Sex Ratio of *Mus rattus* following an Unusual Mortality of Adult Females, based on an Analysis of Weight Frequency Distributions: Dr. F. N. White.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Fifth Kelvin Lecture: Sir Oliver Lodge.

MATHEMATICAL SOCIETY, at 5.30.—(1) A Generalisation of the Euler-Maclaurin Sum Formula; (2) The Deduction of Formulæ of Mechanical Quadrature from the Generalised Euler-Maclaurin Sum Formula: S. T. Shovelton.—Binary Forms: A. Young.

FRIDAY, JANUARY 23.

PHYSICAL SOCIETY, at 5.—Some Characteristic Curves and Sensitiveness Tests of Crystals and other Detectors: P. R. Coursey.—Exhibition of a Water Model of the Musical Arc W. Duddell.—Further Experiments with Liquid Drops and Globules: C. R. Darling.—A Note on Aberration in a Dispersive Medium and Airy's Experiment: J. Walker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Testing of Materials for Use in Engineering Construction: F. W. Monkhouse.

MONDAY, JANUARY 26.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration in Dutch New Guinea: A. F. R. Wollaston.

ROYAL SOCIETY OF ARTS, at 8.—The Relation of Industry to Art: Sir Charles Waldstein.

INSTITUTE OF ACTUARIES, at 5.—The Extension of Existing Valuation Methods of Grouping Policies by the Employment of a System of Weights: A. E. King.

TUESDAY, JANUARY 27.

ROYAL INSTITUTION, at 3.—Animals and Plants under Domestication: Prof. W. Bateson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.

MINERALOGICAL SOCIETY, at 5.30.—The Genetic Classification of Rocks and Ore-Deposits: T. Crook.—Lawsonite from the Central Coast Ranges of California: Prof. A. F. Rogers.—Mineralogical Notes: Dr. G. T. Prior.—Uniaxial Augite from Mull: A. F. Hallimond.—Apparatus for Grinding Crystal Plates and Prisms H. H. Thomas and W. Campbell Smith.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion:* Superheating Steam in Locomotives: H. Fowler.

THURSDAY, JANUARY 29.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Origin of Thermal Ionisation from Carbon Prof. O. W. Richardson.—The X-ray Spectra given by Crystals of Sulphur and Quartz: Prof W. H. Bragg.—The Temperature Variation of the Photo-elastic Effect in Strained Glass: Prof. L. N. G. Filon.—Studies in Brownian Movement. I. The Brownian Movement of the Spores of Bacteria: J. H. Shaxby and Dr. Emrys Roberts.—The Transmission of Kathode Rays through Matter: Dr. R. Whiddington.—The Variation with Temperature of the Specific Heat of Sodium in the Solid and the Liquid State; also a Determination of its Latent Heat of Fusion: Ezer Griffiths.—Radiation from a Gas: Dr G. Green.—Similarity of Motion in Relation to the Surface Friction of Fluids: Dr. T. E Stanton and J. R. Pannell.—The Influence of Molecular Constitution and Temperature on Magnetic Susceptibility: A. E. Oxley—The Boiling Point of Sulphur on the Thermo-dynamic Scale: N. Eumorfopoulos.

ROYAL INSTITUTION, at 3.—The Mind of Savage Man: His Moral and Religious Life: W. McDougall.

CONCRETE INSTITUTE, at 7.30.—Discussion on "A Standard Method of Measurement for Reinforced Concrete."

SOCIETY OF DYERS AND COLOURISTS, at 8.—(1) The Effects of Mineral Loading upon the Physical Qualities of Hedychium Paper; (2) Tests to Determine the Relative Strength and Elasticity of Some Natural Fibres: Clayton Beadle and Dr. Henry P. Stevens.

FRIDAY, JANUARY 30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Testing of Materials fo Use in Engineering Construction: E. W. Monkbouse.

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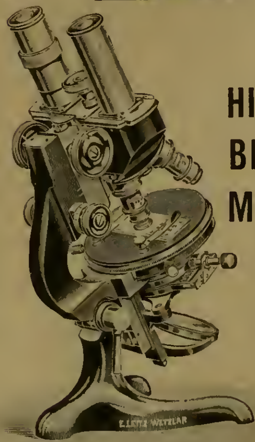

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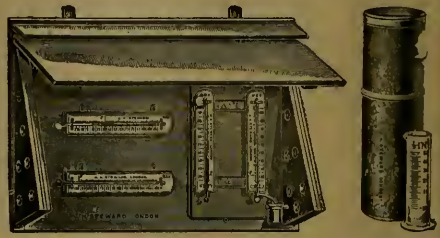

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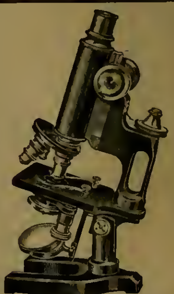

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THURSDAY, JANUARY 29, 1914.

MILLIONAIRE AND NATURALIST.

Letters and Recollections of Alexander Agassiz. With a Sketch of his Life and Work. Edited by G. R. Agassiz. Pp. xi+454+plates. (London: Constable and Co., Ltd., 1913.) Price 14*s.* net.

THIS is an unusually interesting and well-conceived biography, for it gives us a vivid and often a pathetic picture of a truly remarkable man, and a thoroughly readable account of his great scientific enterprises as they followed, one growing from another, during his marvellously active and productive life. Alexander Agassiz was as astonishing for his energy and the magnificent scale of his scientific investigations as he was fascinating and lovable in personal intercourse. It was my good fortune to know him well. Whenever he was in London we dined together; he was my guest at Oxford when I was professor there, and we spent some days together in Paris about ten years ago, when he had settled in his favourite hotel—the *Athenée*—to do a spell of literary work. Few men, if any, of his day gave such an impression of power and intellectual capacity combined with so much light-heartedness and charm of manner.

Alexander was the only son of the great naturalist Louis Agassiz, who came from a long line of Swiss Protestant ministers in the Canton de Vaud. He was born at Neuchatel in 1835, when that place was under the dominion of Prussia. As a boy he was, we are told, "rather quiet, with the bewitching smile so characteristic of the man," and at ten years of age actively sympathised with the Swiss or anti-Prussian party. He incurred the displeasure of the retired Prussian general who was governor of the town by not saluting him politely. That functionary complained to Louis Agassiz of his son's conduct, who accordingly thrashed Alexander. The latter revenged himself by publicly refusing to receive his school prizes at the hands of the governor, and turning his back with scorn on the representative of the king. Subsequently he organised a band of confederates of his own age, stormed the castle on the night of a large dinner party, and smashed all the windows of the state dining hall! In after years Alexander remarked that it was perhaps fortunate he emigrated to the United States at an early age, as, with his views, he would surely in due time have been hanged or shot.

Louis Agassiz went to the United States in 1846, leaving his family (his wife, son, and two daughters) to follow. In 1849 he became settled as Professor of Natural History at Harvard, and sent for his son, whose mother had died in the previous year. Alexander soon imbibed the atmosphere of freedom of his adopted country, and records that "he could scarcely realise that it ever had been possible for a small boy to be nagged and punished for political opinions." A year after Alexander's arrival in Cambridge, Mass., his father brought home his second wife, a rare and devoted woman, who was to Alexander (as he tells us), in the subsequent trials and griefs, joys, and triumphs of life, "his mother, sister, companion, and friend all in one." She died in 1907, only three years before her stepson, having long survived his young wife, who died in 1873, and his father, who died at the same time. Alexander writes of his step-mother:—

"The like of her we shall not see again. From the time that I first saw her, and I only a small boy of thirteen, there never was a word of disagreement. She belonged to me and I to her; it could not have been otherwise."

I have just turned over the pages of the book which they produced together in 1865—"Seaside Studies in Natural History"—the admirable drawings and observations (many of them new and of great importance) on Medusæ, Polyps, and Echinoderms and their young stages, by Alexander, whilst the text is written by his "mother," for so he always called her.

The young Agassiz, after a couple of years at school in Cambridge, entered at Harvard in the autumn of 1851, at the age of fifteen. His friends tell us that he already possessed an unusual power of concentration and a gift of accomplishing what he intended to do. He was slight but remarkably powerful and active. He pulled in the University crew and retained his interest in rowing all through his life. After four years "in college" (corresponding, apparently, to the old bachelor-of-arts course of Oxford and Cambridge a hundred years earlier), Agassiz entered the engineering department of the Lawrence Scientific School, and graduated in 1857, at the age of twenty-two, and then studied chemistry. In 1859 he obtained the position of aid on the United States Coast Survey, but gave it up and returned to his father's museum in Harvard on a salary of 300*l.* a year. On this income he married Miss Anna Russell, the sister of the wife of his classmate, Theodore Lyman, and settled down to a life of the most rigid economy, but surrounded by friends and occupied with interesting work. He now published his classical works on the embryology of Echinoderms and on North American Acalephæ, illustrated by 360 figures drawn by his own hand. He had a laborious duty in the charge of the correspondence

 Z

and exchanges of the great museum which his father was gradually building up by the aid of grants from the State and handsome private subscriptions in procuring which he was irresistible. Alexander's filial devotion was intense, and he willingly gave himself to the furtherance of his father's great plan.

Now, in 1867, came the great opportunity of his life. The story is given in full and interesting detail in the volume of "Letters and Recollections." Briefly it is this, and, as his son observes, it reads more like a page of "Monte Cristo" than a forgotten leaf from the early history of Northern Michigan. A road surveyor named Hulbert stumbled on to a deserted Indian "cache" of native copper at Calumet, in North Michigan, and blasting below it discovered a great lode of copper conglomerate. Alexander Agassiz's two sisters had married men of some means, and these gentlemen acquired the copper-bearing district discovered by Hulbert, and some neighbouring copper-bearing land in which Alexander, after inspecting it, also secured an interest, borrowing a small sum for the purpose. Alexander, who was a trained engineer and had gained valuable practical knowledge in managing a coal mine, was entrusted by his relatives with the job of getting the property (which was being mismanaged) into working order. He gave up his work at the museum and made the great effort of his life. Meeting in the streets of Boston his friend Charles W. Eliot, who later became President of Harvard, he said:—

"Eliot, I am going to Michigan for some years as superintendent of the Calumet and Hecla mines. I want to make money; it is impossible to be a productive naturalist in this country without money. I am going to get some money if I can, and then I will be a naturalist. If I succeed I can then get my own papers and drawings printed, and help father at the museum."

Seldom, indeed, as his biographer remarks, have the aspirations of youth proved in such harmony with the achievements of maturity.

Agassiz stayed from the early spring of 1867 to October, 1868, in the wild region where the copper mines were situated. He entirely altered the method of extraction, introduced new machinery on a very large scale, chose his subordinate officials with unerring judgment, and was the very life and soul of the place; but it nearly killed him, and, in fact, he never recovered from the strain and exhaustion of that eighteen months. In the midst of it he writes to his brother-in-law:—

"Keep up courage, and never give up. We shall be all right yet. The thing I drive and look after is the only thing that goes; and just as fast as I pass from one thing to another, just so fast do things move. There is not a thing done, down to seeing that cars get unloaded, which I don't have to look after myself, and some days I am in utter despair."

By October, 1868, he had overcome all difficulties and opposition and returned to the more congenial labours of the man of science awaiting him at Harvard. Ever afterwards, even to the end of his life, he paid a visit to the mines in the spring and another in the autumn, and more than one voyage of exploration was postponed owing to an unsatisfactory condition at the mine that required his personal attention. His care was given not only to profits, but to the welfare of his employés. A few years ago the Governor of Michigan said that there was one man who had done more than all others in that country for humane and reasonable conditions of life among its working people—Alexander Agassiz.

In August, 1868, the Hecla and Calumet mines produced 330 tons of refined copper. In 1909 the product of refined copper for the year was at the rate of 4000 tons a month. The area which has been mined and opened up in the region of the conglomerate lode since Agassiz set it going can be measured now in square miles, the shafts and drifts amount to 200 miles in length, and 37 million tons of rock have been lifted, 9000 tons are removed every day, and 5600 men are employed in the works. Since the Hecla and Calumet mines paid their first dividend in 1869, the company has paid to its stock-holders the huge sum of 20 million pounds sterling. Called as a last resort to prop up a failing enterprise, Alexander Agassiz transformed it into one of the most prosperous and extensive mines known in the history of industry. He has left the mine as a remarkable proof of his extraordinary executive ability and business foresight. Few men can show such a monument as the result of a life's work; yet in this case it was the by-product of the brain of a man whose life's interest was abstract science. And to scientific research and the realisation of his father's great project of a vast museum he devoted the leisure and the wealth which now became his.

"His versatile and restless energy (writes his son) covered an extraordinarily wide field. The morphologist considers his earlier work the most important; the geologist that his reputation rests chiefly on his extensive investigations of coral reefs; the zoologist remembers his vast collections of marine life gathered in a dozen extended voyages widely scattered over the surface of the globe; and to still others he appears as the creator of a vast museum and one of the greatest benefactors of the oldest university in

America. In the world of affairs he was known as an extremely capable and successful mining man, who was said to employ his leisure moments in some sort of scientific study."

The story of his numerous expeditions in tropical seas which became almost annual fixtures, since he suffered severely in later life from exposure to the winter climate of New England, is given with some fullness in the present volume, and especially good is the account of his series of investigations of coral reefs and atolls in the West Indies, and in the Indian and Pacific oceans. These chapters will well repay the reader.

But here I am more anxious to cite passages illustrating the personal qualities of Alexander Agassiz, first as shown in his deliberate application of the great wealth which he acquired by his own efforts so early in life, and secondly as exhibited in the contrast which in many respects he presents when compared with a man of an equally wide public reputation, his much-loved and gifted father Louis Agassiz. During his life Alexander Agassiz made contributions to the Museum and University of Harvard which amounted to three hundred thousand pounds sterling, and a further very considerable sum will eventually pass to the University which he has specially ear-marked to provide posts in the Museum for the maintenance of investigators who are to be free from the burden of class-teaching. On university matters I was in entire sympathy and accord with him. He deplored, in regard to Cambridge, Mass. (as noted in this book), the same antiquated and seemingly irremovable errors in organisation, and the same failure to recognise the university as a great seat of living progressive science, which we still bravely struggle against in the old country . He wished to see American universities modelled on the German system. Writing not long ago of his expenditure for science, he says:—

"While the sum total seems a large expenditure, and one which appeals to the public and to the University officials, I hope that my influence on science at Cambridge will not always be measured by the dollar standard, as it is so apt to be. What I care for far more is the recognition of the fact that, having the means, I have backed up my opinion of what was worth doing by a free expenditure of funds, and furthermore that I have since 1870 devoted my time as completely to the interest of the Museum as if I had been working on a salary of fifteen hundred a year. And that since that I have published the results of my work continuously, and hope to be judged by that, and not by the total I may have spent for the same. I want to go down as a man of science, and not to be temporarily known by a kind of cheap notoriety as an American millionaire."

Whilst pouring out his fortune for science with one hand, he was (his son tells us) generous almost to a fault to his children with the other.

Alexander Agassiz inherited from his father a love of science and an extraordinary ability and love for work; but his sensitive and apprehensive temperament he acquired directly from his mother. Father and son had less in common than may be supposed. The father's optimism was always a cause of anxiety and trouble; the son possessed a singularly clear sight for the rocks ahead, and a very remarkable ability to steer his course clear of them. The older Agassiz, buoyant and robust, loved appreciation, was fond of teaching, and had a genius for stimulating his students. He had a large measure of the poetic and imaginative quality which is necessary for the making of an original discoverer. Alexander, retiring and reserved, had no gift or desire to excite popular interest; he hated notoriety, disliked teaching, and his intellectual life was devoted to research. He was extremely cautious in speculation, and, indeed, on this account—though he rendered immense service to science by the accumulation of important facts and the discovery and description of new species often of great interest, and the exploration in a magnificent way of regions of the ocean previously unvisited—he yet is not the author of any great generalisation or theoretical advance in the science to which he devoted himself.

As he matured and saw his way to large results, he aimed at the solution of two big problems; (1) the amount of variation from type that may be expected in a given period of geological time, as illustrated by the difference which has ensued in the oceanic fauna on the two sides of the Isthmus of Panama since the days *when the Caribbean was virtually a bay of the Pacific*. He made immense collections by means of large and costly expeditions, and employed pretty well all the specialists of Europe as well as America, and his own special knowledge of the Echinoids, to report on the material collected on each side of the Isthmus *with this end in view*. It is one of the tragedies of a life so full and richly employed as his was that his "Panamic Report," so long looked forward to, was never written.

The other problem dealt with by Alexander Agassiz was that of the formation of coral reefs and atolls. He visited every coral island region in the world, and published richly illustrated surveys of them. He was opposed to Darwin's theory of the origin of coral atolls by the subsidence of the areas in which they occur. And he certainly succeeded in showing that the views advocated by Darwin and by Dana are not capable of universal application, nor, indeed, possessed of general validity.

Alexander Agassiz was drawn into his life-long occupation with zoological science by his love for his father, and a determination that the Harvard Museum commenced by that father should be carried through and become, as his father had intended, as great or greater than the greatest zoological museum in Europe. He frequently said that he did not care for museum work himself. He preferred to study fresh living material. But a determination once made by Alexander Agassiz, and based upon the strongest and most beautiful feature in his character—his filial devotion—was an irresistible force. The Museum of Comparative Zoology is now what he determined it should be—marvellous for its rich collections, its spacious galleries and laboratories and its splendid organisation and equipment in staff and facilities for investigation. On a tablet in the entrance hall is inscribed "Ludovici Agassiz Patri filius Alexander."

Alexander Agassiz had not studied as his father had done—medicine. His zoology did not rest upon a physiological basis. I cannot but think that the cast of mind, which dealing with definite physical problems enabled him to overcome all obstacles and to organise the Michigan copper mines with such triumphant success, would have led him to even greater achievements in the field of experimental science than those which were the outcome of his magnanimous devotion to the work and development of the museum begun by his father.

A few more personal details remain to be told, and I have finished. Like many other great men who have found a large part of their life's interest on the ocean, he suffered frequently from sea-sickness, but never let it interfere with his purpose. He was a man of quick temper, and, as he showed in childhood, resented injustice and arrogant domination. An instance of this virtue is related by his son, telling how in his later life, on one of his visits to Berlin, he was insulted in a restaurant by two German officers, one of whom, after some altercation, started to draw his sword. But before he could get it out of the scabbard, Agassiz knocked him down with a chair. The matter was taken up by the American Embassy, with the upshot that the officer was forced to apologise.

A great grief came to Alexander Agassiz only four years after he had established the Michigan copper mine and assured for himself a magnificent fortune. In 1873, when he was thirty-eight years old, he lost in the space of eight days both his father and his young wife. The life-long sorrow increased the natural reserve of his character. He wrote some months later to Huxley:—

"Few young men have reached my age and attained, as it were, all their ambition might desire; and yet the one thing which I crave for and which I want to keep me interested in what is going on is wanting. How gladly would I exchange all that I have for what I have lost."

And as late as 1891 he writes:—

"I have been in all that I have undertaken most successful from the world's point of view, but from mine—it has lost its charm long ago."

Yet there were many happy days in store for him. His wife left him three young sons who grew up to be the companions and devoted admirers of their father. They are remarkable men, worthy bearers of their illustrious name. One of them has produced the admirable book which has been the subject of this article. But there is no zoologist among them.

Let me conclude with a citation of a piece of wisdom from a letter on educational problems written by Alexander Agassiz to his friend Charles Eliot Norton:—

"The sooner the educators of the country recognise the fact that at sixteen to eighteen a boy's brain will do some things and not others, the better; and furthermore that all brains are not alike, and never will be, and cannot up to that time be developed alike, nor in the same direction."

Weighty words from so determined and successful a man!

Alexander Agassiz died quietly in his sleep on Easter Sunday, March 27, 1910, at sea, on his way home from Egypt, where he had passed the winter. The ship (the *Adriatic*) was four days out, and he had spent the evening chatting in the smoking room with a few friends. He lies beside the wife of his youth, whom he had buried thirty-six years before in Forest Hills.

E. RAY LANKESTER.

SCHOOL GARDENING.

(1) *Principles and Practice of School Gardening.* By A. Logan. Pp. xv+313. (London: Macmillan and Co., Ltd., 1913.) Price 3*s*. 6*d*.

(2) *Educational School Gardening and Handwork.* By G. W. S. Brewer. With an introduction by the Rt. Hon. Henry Hobhouse. Pp. xi+192. (Cambridge: University Press, 1913.) Price 2*s*. 6*d*. net.

(1) THE author points out that nature-study, as usually carried on in elementary schools, is purely observational, and that, at twelve years of age, the pupil's interest in the acquisition of information by this means begins to

flag, unless it aids him in action that requires thought. It must, in fact, be "thought-compelling with a view to action, mental or physical, or both." Gardening is held to provide the new stimulus that is necessary. In gardening, however, the study of nature must still be continued. A course of practical work is therefore described, in which the principles underlying each operation are sought for, these being often made the subject of experiment. The only danger is that in following the course the teacher's zeal for experiment may outrun the pupil's desire for information. Probably Mr. Logan, whose reputation as a leader in the school gardening movement in the north of Scotland has long been established, would be the first to warn teachers against making this mistake.

The practical work of the school garden is well described. The chapters on the cultivation of the plots are followed by chapters on propagation, manuring, soil organisms, fruit culture, and plant diseases. Each is full of useful suggestions for the teacher. The workshop is made the adjunct of the garden, and a number of garden appliances are described which can be made in the woodwork class. This, together with "correlated exercises" in geography and arithmetic, help to show how to link up gardening with the rest of the school curriculum.

The book can be commended to teachers of rural schools, both elementary and secondary.

(2) In the opinion of the author, school gardening is more often carried on as if the mere acquisition of knowledge were the object, than as a process of discovery, which, as in other forms of handwork, leads to self-dependence gained through experience of both failure and success. His book therefore contains less horticulture than in previously published manuals, but more educational suggestion, and this is put so forcibly that every school teacher of gardening would do well to read it.

A vivid idea is given of the educational possibilities of gardening. Though Mr. Brewer deprecates any forced correlation, his pupils' knowledge of even the primary subjects would develop by working in the manner he suggests. Moreover, the natural history of the garden has to be studied, garden requisites have to be made in the workshop, and simple, though exact, experiments of a kind likely to suggest themselves to the pupils have to be made. The practical examples given are of exactly the right type to capture the interest of boys of eleven to fourteen. In fact, working on such lines they would want no teaching; they would teach themselves.

OUR BOOKSHELF.

Vergleichende Physiologie und Morphologie der Spinnentiere unter besonderer Berucksichtigung der Lebensweise. By Prof. F. Dahl. Erster Teil: Die Beziehungen des Korperbaues und der Farben zur Umgebung. Pp. vi+113. (Jena: Gustav Fischer, 1913.) Price 3.75 marks.

THIS book is the first instalment of a work dealing exclusively with one class of Arthropods, to wit the Arachnids. It is an account of the external form and coloration of these animals in relation to their surroundings, and the author's point of view set forth in the preface will commend itself to many zoologists, especially those who have to teach young students.

The first thirty pages contain a systematic review of the group down to the families thereof, and the illustrative woodcuts are excellent. After proclaiming himself a convinced Darwinian, Prof. Dahl discusses such topics as the advantages of a land and of a water existence, changes of function resulting from changes in the mode of life, and the physiological meaning of bilateral symmetry. The forms of appendages and eyes are next dealt with, though we are not told why the sessile rather than the stalked eye is the rule in Arachnids, while the number of "legs" in the Pycnogonids is admittedly baffling. In his account of the parasitic members of the group and the changes in form dependent on parasitism, the author is at his best; and it will be news to many that a pseudoscorpion is to be found on children's heads hunting for other ectoparasites, while a mite (Tyroglyphus) lives on harmful fungi in the bones of birds, and is itself preyed upon by two species of another mite (Cheyletes). Finally, the question of coloration is fully discussed, with many interesting illustrations, though no allusion is made to Sclater's discovery of a spider that mimics a leaf-cutting ant.

Matter and Some of its Dimensions. By W. K. Carr. Pp. 120. (London and New York: Harper Brothers, 1913.) Price 2s. 6d. net. (Harper's Library of Living Thought.)

THIS book will scarcely be appreciated by those who like an author to remain in touch with actual fact when presenting scientific achievement in a popular manner. It abounds with misstatements, such as that "bodies which emit electrons are known as radio-active," and that "radio-active bodies emit an emanation which . . . wholly disappears by transforming itself into electric particles" (p. 22). The æther, as usually in this type of work, plays a prominent part. It is described (p. 37) as a "jelly-like mass," and "mathematicians" are said to assume that there are several æthers, possibly five. But the author supposes that they are infinite in number, and adds, "We have at least conceived a method, and a very orderly one, by which man can evolve for all time, existing in each ring, or plane, or dimension of matter so long as he supplies the conditions of existence." There are some rather more pleasing chapters on truth and on the "fourth dimensional consciousness," but one would have preferred these speculations without their quasi-scientific sprinkling.

Continuity. The Presidential Address to the British Association, Birmingham, MCMXIII. By Sir Oliver Lodge. Printed in full and supplemented by explanatory Notes. Pp. 118. (London: J. M. Dent and Sons, Ltd.) Price 1s. net.

It will be remembered that Sir Oliver Lodge's presidential address to the British Association was printed in full in the issue of NATURE for September 11 last (vol. xcii., p. 33). Its republication with twenty-four pages of explanatory notes should ensure renewed attention to the important subjects with which it dealt.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Aristotle's Physics.

I AM unable to find the passage in his works, but I think it was Prof. Ostwald who pointed out that while Aristotle was much more impressed with the retarding effect on the velocity of the mass of the medium through which the falling mass fell, than with the laws of "free fall," Galileo ignored friction, and discovered the law of fall in a vacuum. Neither was right; but air at atmospheric pressure has a very small effect on a dense mass falling, and hence Galileo was able to establish his law. Had Aristotle pursued his line of thought, he might, with adequate experimental appliances (which he had not got) have discovered Stokes's law.

This forms a very good example of the necessary restrictions in all scientific reasoning. In all events the factors are too numerous to permit of absolute coincidence between theory and experiment; the successful discoverer is he who takes care to eliminate the less important factors; it is he who arrives at a law, which, though not exact in correspondence with fact, still enables progress to be made. Further progress ensues, when account is taken of each disturbing factor, one by one; the initial simple law becomes more complicated, but a nearer approximation to truth is arrived at.

WILLIAM RAMSAY.

19 Chester Terrace, Regent's Park, N.W.
January 23.

CAPT. HARDCASTLE's authentic quotations from Aristotle are most interesting. May I as a teacher emphasise the fact that "terminal velocity" is the best instance of Newton's first law of motion in actual operation—an instance strangely neglected by elementary exponents. On anything moving at constant speed in a straight line (like a passenger in a railway train) the resultant force acting *must* be zero, and, so far from "inertia being eliminated" from such a body, its progress is due wholly and solely to its own inertia. Non-Newtonian mechanics need not be referred to in treating so rudimentary a matter.

OLIVER LODGE.

Mariemont, Edgbaston, January 24.

The Eugenics Education Society.

WILL you allow me, through your columns, to point out another aspect of the present methods of popularising "eugenics"? I had recently occasion to criticise this popularisation, and especially the methods of the Eugenics Education Society. I then used the following words:—"Sir Francis Galton was in the problems of race an optimist—a splendid optimist; but even he *in the last few months of his life* saw that the popular movement he had started was likely to outgrow its knowledge, and feared that more evil than good might result from it" (*The Times*, October 15, 1913).

In the present number of the organ of the Eugenics Education Society there is some criticism of the words used by me. It starts as follows:—"We would, if possible, avoid all controversy with one who has done so much for our science, and who was, moreover, so highly trusted by its founder, Sir Francis Galton, as is evidenced by his will. One sentence, however, cannot be passed over in complete silence, namely, the following: 'But even he (Sir F. Galton) *in the last years of his life* saw that the popular movement, &c.'"

The italics are mine, and these words are followed by quotations from the letters Sir Francis wrote in 1909, and one from October, 1910. The controversial methods which can change "last months" to "last years," and then cite letters of 1909, are characteristic of that looseness of procedure which must eventually be fatal to any popular movement run by this society. It suffices to say that on my last visit to Sir Francis Galton at Haslemere at the end of December, 1910, he expressed distrust of the lines on which the society was being run, that he was then in doubt as to whether he would not do better to resign his honorary presidency, and that I personally declined to influence his judgment in any way by discussing the subject, because he was as able then as when he was fifteen years younger to decide for himself.

When my "Life of Sir Francis Galton" is published his letters will show the exact field of work he proposed for the society and his appreciation of the dangers that might arise from its action. My only excuse, sir, for troubling you in this matter is that the organ of the Eugenics Education Society is a quarterly, and I have no other effective means except through the courtesy of your columns to correct a wholly erroneous statement, which the editor of that society's journal has put into my mouth.

KARL PEARSON.

Galton Laboratory, University of London,
January 23.

Some Habitats of a Marine Amœba.

IN a letter to NATURE (No. 2300, vol. xcii.) I described a common habitat of a marine Amœba, and in view of the subsequent discussion of this matter in letters to NATURE it will be of interest to record some further observations bearing on that discussion.

In the letter to NATURE mentioned above it was shown that a marine Amœba, which agreed in many of its characters with *Amoeba crystalligera* of Gruber, could be fairly constantly obtained from sponges of the genus Sycon, by squeezing out the contents of the gastral cavities of these animals. At the same time it was stated that this habitat of the Amœbæ is not likely to be an exclusive one. When, therefore, Prof. Dendy suggested in NATURE (No. 2301) in the following week that these Amœbæ might be sponge germ-cells, or even metamorphosed collar-cells, I at once began a search for the Amœbæ in other situations. This search was successful; Amœbæ in all respects similar to those obtained from the sponges were found in three separate places. On one occasion they were found among matted masses of the Polyzoan, Bowerbankia, on another in a pocket occurring in a pendulous colony of Botryllus, and on another occasion they may have been in the same situation as the last, or they may possibly—but not probably—have been present in the mantle cavity of the Botryllus colony. On obtaining these free-living Amœbæ I started a culture of them in petri dishes, and also a culture of Amœbæ from sponges. The former culture is now in a healthy condition, and there has been a large increase in the number of individuals. The culture from sponges begun on December 10 yielded an increasing number of Amœbæ, until on December 24 there were numerous specimens all over the bottom of the dish. About December 30 this culture began to decline, the Amœbæ becoming replaced by Ciliates, so that at present only occasional specimens can be found even by careful hunting. The food of the Amœbæ in these cultures was probably bacteria, but occasionally algal inclusions were to be observed, and in one case an included diatom was almost certainly a Nitzschia, a culture of which I added to the Amœbæ.

During the progress of these cultures no dividing Amœbæ were seen, although they were looked for, but a few days after starting the cultures a large number of small Amœbæ were noticed. These small ones undoubtedly grew larger, as the progress of the cultures showed. And indeed various sizes of these Amœbæ from about $30\,\mu$ by $12\,\mu$ to $80\,\mu$ by $40\,\mu$ were obtained, both from sponges and the free-living habitats mentioned above. Unfortunately in my former letter I gave the size only of what I considered to be the adult form, and have thus misled Prof. Dendy into the error of supposing that they are too large to be the germ-cells of the sponge. The mature oocytes of Sycons are about $35\,\mu$ in diameter, when stained and mounted, whereas a large, living Amœba in a spherical condition, measured about $45\,\mu$ in diameter, but even allowing for shrinkage of the oocyte, it is probable that it would be somewhat smaller in the living state than a large Amœba. Moreover, as Mr. Bidder has pointed out, the adult Amœbæ are too large to be the metamorphosed collar-cells of the sponges, and it may be added so also are probably even the smallest ones.

Indeed, the identity of the free-living Amœbæ and those obtained from sponges as indicated by their general characters and their similar behaviour under culture, apart from the fact of the ingestion of diatoms, is sufficient to establish these animals as independent organisms.

It is an interesting fact that the largest forms of these Amœbæ when flowing quickly can travel their own length in about 40 seconds. One specimen was observed to travel nearly six times its length in a little more than seven minutes, making various stops and meanderings on the way.

J. H. Orton.

The Marine Biological Laboratory,
The Hoe, Plymouth.

Projective Geometry.

Are not the references to the "epidemic of projective geometries" in a note in Nature of January 1 (p. 510) somewhat unfair?

It is complained that they "may teach pupils to copy out proofs of stereotyped bookwork." The best of the treatises contain an excellent selection of problems calculated to give the student a firm grasp of fundamental geometrical ideas. As for "problems in mechanics involving a conic, cycloid, or catenary," the geometry required is usually closely connected with the calculus, and is to be found in text-books on that subject.

Without doubt the calculus is the most important branch of mathematics, and should come as early as possible, but to those who are interested in the geometry of conics the powerful methods of projection and reciprocation form a natural and attractive sequel to the usual elementary course on the straight line and circle.

H. Piaggio.

University College, Nottingham, January 1.

I agree with Mr. Piaggio that projective geometry is a pleasant and suitable subject of study for arts students, especially women, who are reading for honours with a view of entering the teaching profession. But for such students a single text-book written by an eminent pure mathematician would be better than the present array of books, the authors of many of which have not added much to our knowledge of mathematical science. Further, Mr. Piaggio forgets that these arts candidates are not the students who want their calculus so early; indeed, they flourished and prospered as well thirty years ago, taking their calculus late, as to-day, perhaps better.

It is for the science student who combines pure mathematics with mechanics, physics, and chemistry that the early calculus is most needed. The geometrical properties of space involved in the study of physical problems are almost invariably essentially metric, and a course in projective geometry will appear to such a candidate as a blind-alley, affording very little outlook. Although I liked the subject myself, I cannot remember a single outside problem to which I could apply my knowledge of it. On the other hand, the geometrical properties of conics and other curves are constantly involved in applications to mathematical physics, where their significance can only be properly understood when the curves have been studied from first principles. Mr. Piaggio considers that this geometry is contained in text-books on the calculus, but the treatment in these books—especially in the case of the conic—is quite inadequate, and, moreover, is almost invariably too analytical. The old dividing line between geometrical and analytical conics was, of course, a mistake, but its abolition has led to the failure of students to study these curves *from first principles*, with the result that the metric geometry of curves, especially conics, is neglected, and students of physics get into the difficulties mentioned in my note. Now it will be found that the authors of many of these text-books run down the study of geometrical conics, and propose these projective methods as a substitute, and my object is to point out that so far as my experience goes this substitution leaves the student of mathematics combined with physics much worse prepared than he was before.

A former pupil, now a lecturer, once brought me a proof that the path of a certain particle (I believe an electron) was a cycloid. He had worked it out analytically; but I pointed out that the result followed immediately from first principles.

By all means let projective geometry be taught, but let its place be beyond the dividing point at which students of pure mathematics and of physics branch off in different directions. There is plenty of other work which is now crowded out of the course common to all candidates, which possesses pressing and urgent claims for inclusion therein.

The Writer of the Note.

Zonal Structure in Colloids.

The notice of Prof. Küster's work on zoning in colloids in Nature of January 8 suggests to me that such an influence is often manifest in our concretionary formations.

In 1912 Prof. S. Leduc, after seeing some of my photographs of the Sunderland Magnesian Limestone, suggested osmosis as the cause (see his "Biologie Synthetique," p. 176). This still awaits demonstration.

Two processes appear to me to have been at work in this concretionary limestone. The first step was, I believe, the production of rod structures starting at every possible angle from "bands of origin," and lying either parallel to or divergent from one another. Both forms are shown in the photograph of a vertical section at Fulwell Hill ($\times \frac{1}{4}$). The rods are often seen in a double series pointing in opposite directions, though they are certainly never of stalactitic origin. The second process seems to be similar to that which produces Liesegang's rings; this caused a deposit of lime in zones (Fig. 1) across the rods, whatever position or arrangement. They commenced as nodes on the rods, ultimately by extension forming parallel bands. The process often halted at various stages of development, but specimens are found showing a complete series of such changes and suggesting an easy classification.

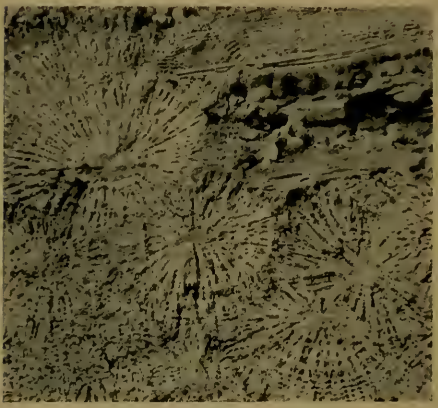

FIG. 1.

GEORGE ABBOTT.

2 Rusthall Park, Tunbridge Wells, January 15.

Weather Forecasting.

Of the sciences, meteorology is perhaps the one which most deserves and requires State-aid. Even to the individual whose business is not affected directly by the weather, a more certain knowledge of the atmospheric changes which may be expected to take place during the day would be of very considerable value. Thanks to our Meteorological Office, we can even now ascertain from the morning papers what the weather conditions of the day are likely to be; but it is generally conceded that even the official weather reports sometimes prove untrustworthy. By some weather experts forecasts are issued for three days in advance. Such forecasts, however, are much more untrustworthy than the daily ones. Indeed, weather changes are frequently so rapid that in the course of twenty-four hours the atmospheric conditions may be almost entirely changed over the whole of Europe.

There is no reason to suppose that any insuperable difficulty stands in the way of accurate weather forecasting; but individual effort cannot be expected to bring together, and put in proper form for study, the vast amount of detailed information from distant regions which must be dealt with.

To be of real service, correct forecasts should be published for at least seven days in advance. Such forecasts would be of great value to the agriculturist. It does not seem to be quite appreciated how great an interest agriculture is, even to a manufacturing country like England. Compared with it the 18,000*l*. per annum provided by the State for the carrying on of the work of the Meteorological Office is an insignificant figure. Indeed, that so little is spent on this department would seem to imply that those who are responsible for providing what is required take an altogether incorrect view of what might really be accomplished. One unexpected storm will often do ten times as much damage to agricultural produce and shipping as would provide all the money that is required.

It is difficult to believe that in these days when scientific method has led to such enormous improvements in the conditions under which we live, there are those who believe that meteorology is a science which cannot be expected to assist greatly in promoting the general welfare. That meteorology has not made more rapid strides is due to the fact that it is pre-eminently a science which requires organised effort of a kind which the individual meteorologist cannot undertake. What is required is an organisation the efforts of which are mainly directed to the accumulation of facts, and, what is of equally great importance, the publication of such facts in a form easy of comprehension.

A meteorological atlas gives us charts showing mean temperatures, mean atmospheric pressures, &c., but although such charts are useful, indeed indispensable for some purposes, we still require charts giving the actual conditions obtaining at certain times each day. The only charts of this description available are those issued by the British Meteorological Office each week. Although these have greatly improved during recent years, they still leave much to be desired. If they were printed on a larger scale they would be much more valuable. Such charts ought to show the isobars, isothermal lines, dew points, &c. The isothermal lines and dew points would, probably, be distinctive of each wind province.

At the present time the science of meteorology, in so far as the laws governing the changes produced in the air by vertical or horizontal movements are concerned, is well up to date. What is wanted is a clearer knowledge of the nature and origin of cyclones and anticyclones. Correct conclusions can only be drawn from charts showing correctly the conditions actually obtaining over large areas at particular moments.

It must not be forgotten that every cyclone as it reaches new areas finds there wind conditions the nature of which exercise a profound influence upon the form of the advancing cyclone. It is not, therefore, sufficient to know that a cyclone is advancing towards us along a certain path. The actual form of this cyclone and the wind and other conditions of the area into which it is advancing, are each of great importance. So complicated are the conditions, and so variable are they, that anything short of daily, or twice daily, charts will fail to provide the material required for ascertaining the laws which govern the circulation of the atmosphere and produce rain, wind, and change of temperature.

A rich country such as England, one in which agriculture and shipping are of such enormous importance, should not fail to furnish material for such a study of atmospheric changes as would render forecasts trustworthy, not only for one day, but for several days in advance. However, any further expenditure of public money should not be granted, unless the information thereby obtained be published in such a detailed form and at such a price that it would be available for the study of all who take an interest in meteorological science. R. M. Deeley.

Abbeyfield, Salisbury Avenue, Harpenden.

Liquid Air as a Fixative.

Last year when Mr. Atkins and I were searching for a method of extracting sap unchanged from various vegetable tissues, treatment with liquid air suggested itself and proved a valuable means for attaining this object. The rapidity of its action in suspending vital processes and chemical changes and in rendering protoplasm permeable, suggested its further application as a fixative. Since then most promising results have been obtained in various cells and tissues by Miss E. S. Marshall, working in this laboratory, showing various nuclear and cytoplasmic structures with great clearness and with a complete absence of plasmolysis. Henry H. Dixon.

School of Botany, Trinity College, Dublin.

Atomic Models and X-Ray Spectra.

It seems scarcely possible that Prof. Nicholson (Nature, vol. xcii., p. 583) requires his two rings of electrons, rotating under the inverse square law, to have one and the same angular velocity; because, if so, the impossibility of two different radii is self-evident; but his letter does not guard against this elementary misapprehension. Oliver Lodge.

Mariemont, Edgbaston, January 24.

AUTOMATIC AËROPLANE CONTROLS.

Much interest has been excited in the announcement contained in the daily Press that Mr. Orville Wright has succeeded in fitting aëroplanes with a device which, according to his statements, renders them as nearly "fool-proof" as anything can be.

This device, as illustrated in the *Daily Mail*, is an absolutely simple one, and works by compressed air. Lateral control is effected by a pendulum which operates an air valve, by which the compressed air is admitted to a cylinder containing a piston connected with the warping device. For longitudinal control, Mr. Wright uses a flat vane, which rises or falls when the air impinges on its under or upper surface; and this is similarly made to operate the elevator.

The compressed air is generated by a small windmill, which will continue to work when the engines are stopped.

I have pointed out in Nature, vol. xci., p. 556, that a pendulum, operating on the controlling devices of an aëroplane, instead of increasing the stability and damping out the oscillations, may produce the reverse effect. It is thus evident that there must be *definite conditions* under which such a device as this may be able to accomplish its object, and that there are equally definite conditions under which it may lead to disastrous accidents. The inference is that Mr. Wright has by experimental tests arrived at a result which satisfies the conditions favourable for automatic control as opposed to those favourable for automatic wreckage.

Apart from the use of a vane for longitudinal control, and a windmill as a generator of compressed air, the invention seems to differ very little from a patent previously claimed by Mr. H. G. Seager, of Colwyn Bay, which I have rather carefully examined, because I am interested in it, and he lives near. Seager uses a pendulum and air pressure, but instead of one he has eight valves, and the same number of cylinders or pneumatics, with the result that he can place his warping devices or elevators in eight different positions, according to the strength and sense of the disturbance requiring to be counteracted. It thus represents a more elaborate control.

There is a good deal of confusion at the present time as to what is meant by stability in aviation, and for this reason "automatic control" would probably be a safer name than "automatic stability" for self-righting devices involving moveable parts. The confusion arises largely from the want of an adequate theoretical basis of comparison in the early days of aviation. Had theory preceded practice, the first experiments would have soon disposed of the divergences between them, which appear to be leading to endless controversies, misunderstandings, and mis-statements at the present time.

Thus in a discussion on stability in *The Aeronautical Journal* for October, recently issued, Mr. J. H. Ledeboer, near the end, says: "So far, everyone who has contributed to this discussion appears to have made the cardinal mistake of confusing stability with controllability, which are essentially different qualities, and are, in fact, often contradictory." And in Mr. Berriman's recent book, while introducing the term "weathercock stability" to designate something which may or may not be synonymous with dynamical stability, he advances the opinion that an absolutely stable aëroplane would never vary its inclination to the horizon, and further that its centre of pressure would always coincide with its centre of gravity. So far from being absolutely stable, the last-named condition might theoretically be described as giving neutral equilibrium, but unstable would be a more correct description.

The success of the Wright device is described both by Wright himself and by his fellow-passenger, Griffith Brewer. The statement that Wright flew several miles without touching the handles is undoubtedly genuine.

While these things are happening in America, considerable interest is still being shown in this country in the Dunne machine, as is evidenced by the recent discussions before the Aëronautical Society. In this case an important feature is that the tendency to excessive banking up in turning curves is counteracted by making the angle of attack negative at the tips of the wings, so that these are really pressed downwards instead of lifted. The principle involved may be stated symbolically as follows, provided that we make the assumptions necessary to simplify the formulæ:—

Let S be an element of the sustaining surface, α its angle of attack, z its distance from the plane of symmetry. Then the lifting power of the surface is proportional to $\Sigma S \sin\alpha \cos\alpha$, while the tendency to bank up at the outer side in rounding curves is proportional to a coefficient which I call L_q, and is proportional to $-2\Sigma Sz^2 \sin\alpha\cos\alpha$, being negative in the ordinary case where an aëroplane tends to rise excessively on the outer side when rounding corners. Now the principle of the "negative wing tip," as Dunne calls it, is represented symbolically by the fact that by making α positive when z is small, and α negative when z is large, you can make—

$$\Sigma S \sin\alpha \cos\alpha \text{ positive,}$$
$$\Sigma Sz^2 \sin\alpha\cos\alpha \text{ zero or negative,}$$

thus giving lift and yet neutralising or reversing the banking action.

There is much to be said for Mr. Dunne's remark: "Finally I must remind you that all my work has been done by practical experiments. It is not the experimental facts which are in question, but the theory which I have evolved to cover these facts, which theory I submit to this learned Society for criticisms. But the facts are unquestioned. The aëroplane does do these things, and if the theory does not give warranty for the practice, then it is the theory which is wrong."

G. H. Bryan.

THE ATLANTA MEETING OF THE AMERICAN ASSOCIATION.

The sixty-fifth meeting of the American Association for the Advancement of Science was held at Atlanta, Georgia, during the week December 29, 1913, to January 3, 1914, under the presidency of Dr. E. B. Wilson, of Columbia University. It was the first meeting which the association has held in the Southern States since the New Orleans meeting of 1905, and was marked by an important series of papers relating indirectly to the industrial advance in the south, to health conditions existing among its people, and to its geological and other resources. The attendance was not large, only about 400 members and fellows registering.

Nine of the national societies affiliated with the American association met at the same time and place, as follows:—

Astronomical and Astrophysical Society of America, Botanical Society of America, American Association of Economic Entomologists, Entomological Society of America, American Microscopical Society, American Physical Society, American Phytopathological Association, School Garden Association of America, Southern Society for Philosophy and Psychology.

The address of the retiring president, Prof. E. C. Pickering, Director of the Harvard College Observatory, was on the subject "The Study of the Stars."

The addresses of the vice-presidents, or chairmen of sections, were as follows:—

A, "The Influence of Fourier's Series upon the Development of Mathematics," E. B. Van Vleck, University of Wisconsin; B, "The Methods of Science: To What Do They Apply?" A. G. Webster, Clark University; C (on account of the absence of Vice-President Miller the address was omitted); D, "Safety and the Prevention of Waste in Mining and Metallurgical Operations," J. A. Holmes, Bureau of Mines; E, "Pleistocene History of Missouri River," J. E. Todd, University of Kansas; F, "The Story of Human Lineage," W. A. Locy; G, "The Evolution of a Botanical Problem," D. S. Johnson, Johns Hopkins University; H (the address was omitted on account of the absence of Vice-President Fewkes); I, "The Development of our Foreign Trade," J. H. Hammond, New York; K, "The Physiological Instruction of Medical Students," J. J. R. Macleod, Western Reserve University (read by title); L, "Science, Education, and Democracy," J. McKeen Cattell, Columbia University.

Two public lectures complimentary to the citizens of Atlanta were given—the first by Dr. C. W. Stiles, of the U.S. Public Health Service, on the subject "The Health of the Mother in the South." In this address, in which some very remarkable facts were told in a very plain way, the speaker urged in a most emphatic manner the segregation of the races in the south, an idea which has heretofore received little attention in the United States, although British sanitarians in the tropical British colonies have appreciated its importance for some years.

The second public lecture was by Prof. C. E. Munroe, of the George Washington University, on the subject "The Explosive Resources of the Confederacy during the War and Now: A Chapter in Chemical History." Prof. Munroe, one of the American authorities on explosives, and for a long time Professor of Chemistry at the United States Naval Academy at Annapolis, dwelt upon the extraordinary activity of the south, isolated as it was from other countries by the blockading vessels of the northern fleet, in developing such resources as they were known to possess, and in manufacturing from them the enormous quantity of explosives which were used by the large southern army during its four years' struggle for independence.

The papers read before Section E (geology and geography) were devoted practically entirely to the geology of the Southern States, and the council of the association has made a grant to secure the publication of these papers in a single volume.

An important symposium was held under the auspices of Sections D and I, on highway policies and engineering, and other joint meetings were held between the Section of Zoology and the American Entomological Society, and between the Section of Botany and the American Phytopathological Association. Under the Botanical Society of America was held a symposium on temperature effects.

Probably the most important symposium of the meeting was held under the auspices of Section K (physiology and experimental medicine), on the subject of Pellagra. The subject was opened by a paper by Dr. J. W. Babcock, Superintendent of the State Hospital for the Insane at Columbia, S.C., on the medico-local relations of pellagra. Dr. E. Bates Block, of Atlanta, discussed the mental disturbances of this disease. Dr. G. M. Niles took an unusually optimistic stand in his discussion of prognosis. The main paper of the symposium was presented by Dr. W. J. Macneal, of the New York Post-graduate Medical School, for himself and his colleagues, Dr. J. S. Siler, Medical Corps, U.S.A., and Dr. P. E. Garrison, Medical Corps, U.S.N., and comprehended an announcement of the later studies of the Thompson-McFadden commission on the etiology of pellagra. During the summer of 1913 the commission has been actively at work at Spartanburg, S.C., and has accumulated and digested a mass of facts bearing upon the etiology which seem to discredit completely all questions of diet, either as to character or amount, and to place the responsibility for the disease upon unsanitary conditions as regards the disposal of excreta; in other words, upon food contamination. The remaining paper was entitled "The Entomological Aspects of the Pellagra Investigation of the Thompson-McFadden Commission," by Mr. A. H. Jennings, of the Bureau of Entomology, U.S. Department of Agriculture. Mr. Jennings having worked for two seasons with the commission at Spartanburg, practically absolved Simulium from any relation to the disease, and stated that if any insect is the vector of pellagra it is in all probability the stable fly (*Stomoxys calcitrans*).

Among the actions by the council were the acceptance of the Society of American Foresters as an affiliated society, the adoption of a resolution looking with favour upon the organisation of a Brazilian division of the association, the authorisation of the establishment of local branches of the association, the continuance of the associate secretary for the south, and the authorisation of the preparation of a directory of the funds available for research work.

A report of progress from the Committee on Expert Testimony was received. The movement to bring the force of the association, composing in its membership so many hundreds of scientific men constantly called upon to give expert testimony in the courts, towards a modification of the present system of employing experts by opposing parties in courts of law, was begun two years ago at Minneapolis. The committee in charge of the work consists of Prof. E. C. Pickering, of Harvard, chairman; Dr. E. B. Wilson, of Columbia; Dr. W. H. Welch, of Johns Hopkins; United States Senator Elihu Root; Dr. A. D. Little, formerly president of the American Chemical Society; and Dr. J. A. Holmes, of the U.S. Bureau of Mines. The committee reported a compilation of the laws of the different States of the union on this subject, and stated that a compilation of the laws of the different nations of the world is in hand. Positive recommendations are to be expected from this committee at the next meeting of the association, and, comprising as it does some of the most eminent scientific men in America, together with one of its most eminent lawyers, the report will carry great weight.

It was decided to hold the next meeting of the association during Convocation Week, 1914–15, at Philadelphia, with a summer meeting to follow in August, 1915, at San Francisco. The general committee recommended to the next general committee that Toronto, Canada, be chosen as the place of meeting for 1915–16, on invitation from the University of Toronto.

The officers elected for the coming year were as follows:—

President: Chas. W. Eliot, president emeritus of Harvard University. *Vice-Presidents* (*or Chairmen of Sections*): A. H. S. White, Vassar College; B, A. Zeleny, University of Minnesota; C (no election); D, A. Noble, New York; E, F. R. Lillie; G, G. B. Clinton, New Haven; H, C. Wissler, American Museum of Natural History; I (no election); K, R. M. Pearce, University of Pennsylvania; L, P. H. Hanus, Howard University; M, L. H. Bailey, Cornell University. *General Secretary:* W. A. Worsham, jun., Athens State College of Agriculture *Secretary of Council:* Henry Skinner, Academy of Sciences. *Associate Secretary:* R. M. Ogden, University of Tennessee.

DR. S. C. CHANDLER.

DR. S. C. CHANDLER, whose death we recorded with regret last week, was not the least conspicuous in that earnest band of American astronomers whose energy and resource have done so much to advance astronomical science. He began his scientific career in the United States Coast Survey, a school that has trained many brilliant observers, who, in positions of greater independence, have rendered valuable service. Dr. Chandler's claim to a place among the most famous of these rests upon three notable achievements. First, the invention and use of the Almacantar, an instrument in which the small circle perpendicular to the meridian passing through the pole is adopted as a fundamental circle of reference, and gravitational action round an imaginary vertical axis is substituted for the motion of rotation round the pivots of the horizontal axis in the case of a vertical circle. Secondly, for his valuable catalogues of variable stars, in which he systematised the results collected by many observers, thereby encouraging and facilitating further observations. His work in this direction was by no means confined to simple compilation. He was both an indefatigable observer and the fortunate discoverer of many interesting objects of this class, ever directing attention to a branch of astronomy that has proved both suggestive and fructiferous.

This habit of industrious examination and critical scrutiny, acquired in discussing many series of observations, proved of remarkable assistance in the successful inquiry with which his name will ever be associated, the detection of the variation of latitude, due to the want of exact coincidence between the axes of the earth's figure and of rotation. This work was exceedingly laborious, necessitating the reduction and collation of many series of observations of zenith distance, and that it was pursued with unswerving determination is the more meritorious as previous computers, misled by Euler's investigation of the behaviour of an absolutely rigid earth, had decided that no term of a periodic character could be detected. Undismayed by this negative result, Chandler, putting aside all suggestive hypotheses, based his inquiry solely on the observations themselves, and accepted the results these offered. He was thus driven to the inevitable conclusion, first, that the latitude variation had a period of 428 days, a decision that was subsequently modified by showing that the complicated motion could be best explained by the superposition of two variations, one in fourteen, and the other in twelve months.

These valuable investigations merit in the highest degree the attention not only of those who are especially devoted to astronomical and mathematical researches, but also of that large and ever-increasing class which is anxious for general knowledge with regard to the physical phenomena of our globe. This work merited and obtained the recognition of the Royal Astronomical Society, which awarded Dr. Chandler the gold medal. It was his greatest achievement, but there are other grounds on which he merits the gratitude of astronomers, who will regret the loss of one who equally adorned the threefold divisions of computational, observational, and instrumental astronomy.

W. E. P.

NOTES.

We announce with profound regret the death on Saturday, January 24, in his seventy-first year, of Sir David Gill, K.C.B., F.R.S., formerly H.M. Astronomer at the Cape of Good Hope.

Before Lord Strathcona was carried to his grave in Highgate Cemetery on Monday, there was an impressive memorial service at Westminster Abbey, at which the King and Queen and Queen Alexandra were represented. The ten pall-bearers, selected on account of their special connection with Canada, or personal relationship with Lord Strathcona, were :—Lord Aberdeen, Lord Lansdowne, Lord Lichfield, the Very Rev. George Adam Smith (Principal of Aberdeen University), Mr. W. L. Griffith (secretary of the Canadian High Commissioner's Office), the Duke of Argyll, the Lord Mayor, Mr. Harcourt (Colonial Secretary), Sir William Osler (regius professor of medicine, Oxford), and Sir Thomas Skinner (deputy-governor of the Hudson's Bay Company). A large number of distinguished people were present at the Abbey service, including representatives of many scientific societies and similar bodies. Among these were Sir William Crookes and Sir Archibald Geikie (Royal Society), the President of Magdalen (the University of Oxford), the Master of Downing (the University of Cambridge), Mr. J. G. Colmer (Canada Club), Sir William Ramsay, Sir Boverton Redwood, and Lady Lockyer (British Science Guild), Sir Frederick Macmillan (National Hospital for Paralysis and Epilepsy, of which Lord Strathcona was president), Sir Francis Champneys, Sir Henry Morris, and Mr. J. Y. W. MacAlister (Royal Society of Medicine), Colonel Sir T. H. Holdich (Royal Geographical Society), Dr. I. H. Tudsbery (Institution of Civil Engineers), and Sir Charles Lyall and Prof. Ernest Gardner (League of the Empire). Lord Strathcona was one of the trustees of the British Science Guild, and took a practical interest in developments of scientific and educational work. His benefactions to McGill University, Montreal, exceeded a quarter of a million; he gave 25,000*l.* to Marischal College, Aberdeen, and endowed a chair of agriculture in Aberdeen University. He also established and endowed the Royal Victoria College for Women at Montreal, and made many other generous gifts to higher education. The Toronto correspondent of *The Times* reports that at a memorial service held on Monday at McGill University in honour of Lord Strathcona, Principal Peterson said :—"The late Chancellor's contribution to education constituted no mere stereotyped or conventional form of benevolence. In scientific, medical, and higher education for women he was a pioneer with a marked power of initiative which had been felt all over Canada."

The wife of Dr. Weir Mitchell survived him only a few days. She became ill shortly after his funeral, and died of pneumonia on January 15. Mrs. Mitchell was in her seventy-ninth year.

Prof. D. H. Tennent, of Bryn Mawr, has completed a biological investigation he has been conducting in Thursday Island in connection with the Carnegie research fund.

Prof. W. M. Davis, the Harvard geologist, is about to carry out an exploration of some of the coral islands in the Pacific. He is so arranging his tour as to be able to attend the meetings of the British Association in Australia.

Dr. E. C. Spitzka, a former editor of *The American Journal of Neurology*, has died in New York in his sixty-second year. From 1885 to 1887 he was professor of medical jurisprudence and neurology at the New York Post-Graduate Medical College.

The death is reported, in his sixty-ninth year, of Dr. G. W. Peckham, a former president of the Wisconsin Academy of Sciences, Arts, and Letters, and librarian of the Milwaukee public library. He was distinguished by his studies in entomology, and had collaborated with his wife in writing numerous works on that subject.

The death is reported, in his sixtieth year, of Dr. B. O. Peirce, who had held the Hollis chair of mathematics and natural philosophy at Harvard since 1888. He was the author of "Experiments in Magnetism," "Theory of the Newtonian Potential Function," and "Table of Integrals," besides numerous papers on mathematics and physics.

On Thursday next, February 5, Sir Thomas H. Holland will begin a course of two lectures at the

Royal Institution on types and causes of earth crust folds. The Friday evening discourse on February 6 will be delivered by Dr. H. S. Hele-Shaw on the mechanics of muscular effort, and on February 13 by Prof. J. Norman Collie on production of neon and helium by electric discharge.

MR. H. LAMSLEY, writing from Watford, states that a queen wasp was seen by him upon his desk in an office on January 22, although the weather was very cold. This early date for a queen wasp to appear is worth putting on record. Curiously enough, we notice that two wasps are recorded in *The Times* of January 24 as having been among the finds reported from the old Roman city of Silchester, Berkshire, during the past week.

AT the last monthly general meeting of the Zoological Society it was announced in the monthly report read by the secretary that the number of visitors to the society's gardens during the month of December was 29,820. The total number admitted during the year was 1,157,974, being an increase of 145,076, as compared with the total for the year 1912. The money received for admission at the gates was 28,223*l*., or an increase of 4479*l*. as compared with the total for the year 1912. The total number of fellows on the roll at the close of the year 1913 amounted to 4733.

WE learn from *The British Medical Journal* that arrangements have nearly been completed for the establishment, as a memorial to Lord Lister in Edinburgh, of a Lister Institute. It is proposed that the institute, which will be devoted mainly to research in bacteriology and pathology, shall work in connection with the University, but that it shall be managed by an independent board consisting of representatives of the Royal Colleges of Physicians and Surgeons, and of the University, and probably of the Carnegie trustees, who have recently become interested in the laboratories of the Royal College of Physicians.

ANOTHER Antarctic expedition is announced, for departure in 1915, and an absence of five years. The Swedish Antarctic Committee, which includes Admiral Palander, Profs. Nordenskjöld, and Gunnar Andersson, and Dr. Nathorst, has secured the financial support of the Government to the extent of half the estimated cost of 15,000*l*. It is proposed to equip a station in Graham Land, with a scientific *personnel* ten in number, which will be supplied during the long sojourn in contemplation by whaling ships, and will carry a wireless telegraphic installation. This appears to be one of those expeditions which will be the logical corollary to the attainment of the south pole, including no sensational feat of travel, and making, therefore, no direct popular appeal, but attempting substantially to extend the scope of scientific research in the Antarctic.

THE annual general meeting of the French Physical Society was held in Paris on January 16. The officers for the new year were elected, and the accounts for the past year presented to the members. From the figures given in the report it is evident that the society is in a most flourishing condition. More than 100 new members joined during the session, the membership now being more than 1600; Paris, the rest of France, and countries outside France each providing about a third of the total. It possesses more than 10,000*l*. of invested capital, and its income for the past year exceeded 1700*l*. The expenses for the year were slightly less, the principal items being the printing of the *Journal de Physique*, 570*l*., and other books and reports issued to members, 300*l*. A series of six lectures on recent advances in physics is to be given during the next three months, the lecturers being Profs. Madame Curie, Mauguin, Mouton, Cotton, Fabry, and Becquerel.

A PHYTOPATHOLOGICAL Congress, commencing on February 24, will be held at the International Institute of Agriculture, Rome, to which all the chief Powers are invited to send representatives. The object of the congress is the devising of an international system for the control of plant diseases, and based upon the suggestions made in 1912 by M. Louis Dop and Prof. G. Cuboni, on the occasion of the general assembly of the delegates of the above institute. Prof. Cuboni has set forth his views on this subject very clearly in an *aperçu* which he contributed to the Bulletin of Agricultural Intelligence and Plant Diseases (November, 1912). In this he states that, though the protection of agricultural plants from disease is a matter of the most vital importance for all civilised nations, little has hitherto been done to obtain any concerted action in this direction. The sole exception is afforded by the Berne Antiphylloxera Convention, established in 1878, and modified in 1881. This, as it stands, is only of interest to vine-growing countries. If, however, its scope were enlarged, so as to include the control of all other contagious or parasitic plant diseases, whether due to the attacks of fungi, or insects, it could be expanded into an International Phytopathological Convention.

A NEW X-ray tube invented by Mr. W. Coolidge, of New York, marks an important step in the progress of radiography and possibly radio-therapy. The principal feature of the apparatus consists in a small spiral of tungsten wire which, when strongly heated by an electric current, becomes a source of electrons, and thus serves as the kathode of the tube.—Surrounding the spiral there is a tungsten ring connected with the negative pole of an induction coil or static machine. This electrified ring repels the electrons from the hot wire so as to bring them to an approximate focus upon a tungsten target (antikathode), where X-rays of varying degrees of penetration are produced. The vacuum within the tube is extremely high, and comparatively wide variations of it do not appear to affect the working of the apparatus. Perhaps the most striking advantage of Mr. Coolidge's tube over the usual kind lies in the readiness with which it can be controlled. The output of X-rays is simply a function of the temperature of the hot kathode, all other factors remaining the same. When once set in action the bulb requires little attention. Thus a tube of this design has been run continuously for about an hour, taking 25 milliamperes of current through it for the whole time, and emitting a uniform radiation of intense penetration. The idea underlying the invention is not quite new, for Dr. Lilienfeldt, of Leipzig, recently introduced a focus tube in which the source of electrons is a heated body.

A DISTINCT advance toward the adequate organisation of sea fisheries investigation has been made by the publication of the first report of the Advisory Committee on Fishery Research. This committee was appointed by Mr. Runciman on January 1, 1913. Its report, now before us, begins with a short account of the deliberations of the subcommittees, and then deals with the various lines of investigation that are regarded as desirable in a series of appendices. Suggestions as to the nature of the work which seems to be required are made with reference to (1) the bottom deposits and fauna; (2) plankton and hydrography; (3) statistical fishery matters; (4) marine pisciculture, including lobster hatching, research on the natural history of the oyster, and experimental work on a large scale with reference to the purification of mussels from contained sewage bacteria; and (5) the detailed investigation of various edible fishes with regard to their distribution and life-histories. Suggestions as to a possible organisation of the various departments or other authorities or bodies competent to carry on such investigations are not made, since much depends on the amount of money available for such research, and on the possible reorganisation of the English Fishery Department; and it is suggested that marine laboratories already in existence may be asked to cooperate in the work of investigation. The report, however, formulates certain general suggestions for fishery investigations, and it now remains for the public departments to embody these suggestions in a working scheme.

The National Geographic Magazine for December last publishes a finely illustrated article by the Rev. W. M. Zumbro, on the religious penances of holy men in India. He gives a remarkable series of photographs representing the many varieties of Fakirs. We see them lying on piles of thorns, or on beds studded with nails, holding piles of water pots on their heads, burying themselves in the ground, swinging on wires, undergoing the ordeal of thirst, hanging head downwards, or holding up their arms until the muscles become atrophied. The subject is painful, but the article is most valuable to anthropologists and to students of Indian religious cults.

IN *Man* for January Messrs. R. B. Higgins and R. A. Smith describe a find of flint implements of the Moustier type, associated with mammalian remains, from the brick earths at Crayford. Not only does this discovery enable us to fix a precise date for the Crayford deposit, but the specimens provide an important link in associating the Thames valley with that of the Somme. It is clear that the implements date from the Moustier period, and they are found with remains of *Felis leo, Canis lupus, Elephas primigenius, Rhinoceros antiquitatis, Equus sp.*, and *Bos primigenius*, according to the identification by Dr. A. Smith Woodward.

IN vol. xxxiii., part ii., of *The Journal of Hellenic Studies*, Mr. K. T. Frost publishes, under the title of "The Critias and Minoan Crete," an interesting paper, a revised edition of a remarkable article which appeared in *The Times* of January 19, 1909. The theory advanced is that the famous legend of the lost island, Atlantis, told by Plato on the authority of Solon, represents the downfall of the great sea power in Crete, with its capital at Cnossus. This legend was derived from Egyptian priests, who preserved the records of the great struggle which ended in the ruin of Minos. The article is valuable inasmuch as it correlates the war in the eastern Mediterranean with the history of Egypt. The tale of the Minoan power before its destruction is identified with the strange description of the Phæacian culture in the Odyssey of Homer.

"ROOT-BORERS and other Grubs in West Indian Soils" is the title of a pamphlet (No. 73), by Mr. H. A. Ballon, issued by the Imperial Department of Agriculture for the West Indies, published apparently at Barbados. A large proportion of the offenders are the larvæ, among which those of the rhinoceros-beetles (Strategus) are capable, on account of their size, of inflicting a great amount of damage, although, as a rule, they act the part of scavengers. The pamphlet is illustrated with photographs of adults and larvæ of many species.

IN the course of an article on endeavours to prevent undue diminution in the number of animals valuable for their fur or plumage, the first part of which appears in the January number of *The Selborne Magazine*, Mr. C. H. Mühlberg gives some interesting details regarding the breeding in captivity of the black or silver fox, for the sake of its valuable fur, which is chiefly carried on in Prince Edward Island. Skins of good quality range in price from 35*l.* to 600*l.*, and it is stated that six pairs of pups were sold in 1912 to a Russian company for breeding purposes at no less than 3200*l.* a pair. The number of foxes now kept in captivity in Canada is estimated at about 800, of which, however, only about 200 carry the fine silvery-black coat which commands the highest price. Attempts are also being made, it is added, to breed chinchillas (which of late years have become exceedingly scarce), for the sake of their fur, both in Buenos Aires and in this country

METHODS for the extermination of locusts in the Anglo-Egyptian Sudan—the species usually met with being *Acridium* (*Schistocerca*) *perigrinum*, Oliv.—are discussed by the Government entomologist, Mr. H. S. King, in the *Cairo Scientific Journal* for November last. The device found most efficacious is to sprinkle a sweetened solution of arsenite of soda on the herbage on which the insects feed. As it is difficult to transport arsenite of soda and treacle on camels and donkeys, and a tent or native dwelling-house is not the most convenient place to carry out the weighing and mixing, Mr. King recommends that a concentrated solution should be prepared at headquarters, and carried to the spot in small iron drums. This can be diluted to the required strength, and thus an immense saving of labour is effected. If the operations are conducted by qualified officials, and the poison is not allowed to reach native hands, no danger can result from this scheme of operations.

The legislation which has been adopted in Ceylon against the diseases and pests of cultivated plants is the subject of a special Bulletin (No. 6) by the Ceylon Department of Agriculture. The bulletin, drawn up by Mr. T. Petch, brings together in a convenient form the regulations as to both internal and import legislation. The latter was commenced in 1901. Under the regulations now in force all living plants, bulbs, &c. (except such as are imported for consumption), also oranges and other fruits of the Citrus family, and cotton seed, are subjected to fumigation with hydrocyanic acid, whilst the seed of tea is fumigated with formalin vapour. The importation of cacao plants from the Dutch East Indies, and pepper plants from India is totally prohibited. Internal legislation was not introduced until some years later, and only after it had been fully discussed with all the interested parties. It was first applied to the coconut beetles in 1907, but it is now extended to the shot-hole borer (*Xyleborus fornicatus*), Hevea canker, and the stem bleeding-disease of coconut.

We have received a reprint of the article on plant ecology ("Oekologische Pflanzengeographie") contributed by Dr. E. Rübel to the "Handwörterbuch der Naturwissenschaften" now being issued by Gustav Fischer, Jena. In this article, which is practically a text-book of the subject, the author deals concisely with the various factors of the environment which determine the characters of the various types of plant community, and after reviewing the various systems of classification of these communities which have been proposed, sets out in detail the classification recently suggested by himself and Dr. Brockmann-Jerosch. In this scheme, plant communities are primarily divided into four types, composed respectively of woody plants, of herbaceous plants on relatively rich soil (meadows in the widest sense), of herbaceous plants on poor soil (deserts in the widest sense), and of free-floating aquatic plants (phytoplankton). The geographical distribution and biological characters of each type are given, and the author has compressed into fifty papers a remarkable amount of information, besides indicating the rapid progress which has been made in recent years in this branch of botany, and indicating the more important recent literature of the subject.

In the second part of the *Verh. Naturhist. Vereins d. preuss. Rheinlande u. Westfaliens* for 1912 (1913) Dr. W. Gothan records the discovery in the neighbourhood of Dortmund, in the Ruhr basin, of a bed containing number of well-preserved Carboniferous ferns. They are of interest not only as being the first obtained from this locality, but from the fact that they include a new species, and also from a distributional point of view. The article is illustrated with three plates.

Dr. Felix Oswald, whose hand-printed work on the geology of Armenia was reviewed in Nature in 1906 (vol. lxxv., p. 197), has rendered his results more accessible by contributing the section on "Armenien" to the "Handbuch der regionalen Geologie," edited by Profs. Steinmann and Wilckens. This is illustrated by a tectonic and a geological map, and by sections (Heidelberg: C. Winter; price 2.80 marks). The author points out the rise of a large part of the region above the sea in late Jurassic times; the two types of marine Cenomanian strata, separated by a gneissic ridge south of Tiflis into an eastern and a western basin; and the folding of marine Miocene strata during the Alpine movements in the Tortonian epoch.

In the *Atti dei Lincei*, vol. xxii. (2) 5, Prof. T. Levi Civita discusses the conditions that must be satisfied by a function in order that it may have an addition-theorem in which a function of $x+y$ is represented as the sum of products of functions of x and of y respectively. The ordinary exponential and circular functions afford illustrations of this property.

According to Torricelli's theorem the velocity of efflux of a liquid from a small aperture in steady motion is equal to the velocity acquired by falling from the height of the liquid surface. From a note published in the *Comptes rendus* (vol. clvii., p. 48) by Prof. T. Levi Civita, it would appear that the same result holds good for the initial velocity of efflux when an opening is suddenly made in the walls of the containing vessel the liquid being previously at rest. It appears probable that this result could be easily tested experimentally.

No. 2 of the *Jahrbuch der Drahtlosen Telegraphie* contains an article by F. Kiebitz on the refraction of electric waves in the atmosphere. Since the upper strata have a smaller density, luminous and electric waves are propagated more rapidly high above the ground than near the surface. This would lead to a bending forward of the wave-front, were it not for the curvature of the earth. The question now arises whether this curvature is sufficient to counteract the "prism effect" of the air. The author studies this question numerically, and finds that, to counteract the curvature, the densities on the ground and 1 km. above it should be in the ratio of 29 : 13. The actual ratio for dry air is 29 : 26, and for moist air about 10 per cent. greater. So far from bending forward, therefore, the waves will lean backward and be deflected into the upper atmosphere. There they encounter the conducting layer, and are reflected downwards, but only if the lower surface of this conducting layer is fairly uniform. Any folding or interruption of this surface will (as pointed out by Sir Oliver Lodge) lead to a reflection towards the origin or a dissipation into still higher strata. Such disturbances of uniformity must occur wherever there are irregular variations of temperature and moisture, more particularly over land areas. It is found indeed that sunshine on land has a deleterious effect on the clearness of wireless signalling. Ideal conditions would be presented by air saturated with moisture, together with a uniformly stratified distribution of temperature. The best conditions are presented in this respect by the Pacific Ocean, where we may expect to attain the maximum ranges of signalling.

A handsome clockwork orrery has just been completed by Messrs. G. Philip and Son, Ltd., 32 Fleet Street, and we have had the opportunity of examining it. Much trouble has been taken to construct a system which cannot easily be put out of order; and the result is an admirable piece of mechanism. The sizes of the planets, with the exception of the earth, are roughly to a scale of 50,000 miles to the inch. The earth is represented by a globe one inch in diameter, and additional mechanism makes the moon revolve around it while the earth itself traverses its orbit. The orrery may be moved by hand or by clockwork, which will keep the planets in motion for about three-quarters of an hour; and it is not put out of adjustment if the clockwork is started after the hand motion has been used. The planets can also be placed in any position in their orbits to begin with; and then when the clockwork is started, they will perform their orbital movements accurately. The satellites are carried round the sun with their respective primary planets, and can be placed in any position around them, but are not connected with the clockwork system. The instrument is mounted upon a heavy mahogany floor-stand, which gives stability to it, and it forms an attractive as well as instructive piece of furniture. Any attempt to represent the bodies in the solar system and their movements by a model cannot, of course, be more than a compromise, but the trouble taken by Messrs. Philip to produce an orrery which is compact and reasonably accurate is worthy of encouragement.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences for February:—

Feb. 3. 19h. om. Venus in aphelion.
5. 5h. 32m. Saturn in conjunction with the Moon (Saturn 6° 50′ S.).
7. oh. 39m. Mars in conjunction with the Moon (Mars 1° 9′ S.).
8. 10h. 38m. Neptune in conjunction with the Moon (Neptune 4° 31′ S.).
11. 8h. om. Venus in superior conjunction with the Sun.
,, 16h. om. Saturn stationary.
12. 13h. om. Mars stationary.
22. 3h. 30m. Jupiter in conjunction with the Moon (Jupiter 2° 56′ N.).
,, 6h. om. Mercury at greatest elongation E.
,, 6h. 41m. Uranus in conjunction with the Moon (Uranus 2° 39′ N.).
24. 11h. 16m. Sun eclipsed, invisible at Greenwich.
,, 20h. 1m. Venus in conjunction with the Moon (Venus 1° 1′ S.).
26. 6h. om. Venus at greatest heliocentric latitude S.
28. 8h. om. Mercury stationary.

Use of the Objective Prism in the Determination of Radial Velocities.—M. Maurice Hamy, who recently proposed an ingenious method of utilising the objective diffraction grating in line of sight work (see Nature, November 27, 1913, p. 383), has just published (*Comptes rendus*, No. 2, vol. clviii.) details of a way in which advantage may be taken of the superior light power of the objective prism for the same purpose. In order to supply the fiducial points necessary to obtain absolute wave-lengths, M. Hamy has devised means whereby the stellar spectrum may be photographed down the middle of a comparison spectrum of a terrestrial light source taken with the help of a collimator. Whilst the details of the instrumental contrivances by which the stellar and terrestrial spectra are brought into proper coordination, as well as the theory of measurement and reduction of the resulting plates are too complicated to be described here, we may indicate that this adjustment is secured by making successive images of the star and middle of the slit reflected by the polished and silvered base of the prism viewed in a second reflector near the camera end coincide with the point of intersection of two wires. The realisation of the idea should delight the heart of some instrument-maker. Measurement need not be confined to the particular star on which the settings are made, as M. Hamy shows that it is possible to utilise all the spectra registered during the one stellar exposure.

A Monument to "The Hour."—The *Revue Scientifique* for January 10 states that M. Lecornu, a member of the Paris Academy of Sciences, has suggested a proposal for the erection of a monument to "the hour," to perpetuate the remembrance of the international standardisation of the hour (March 9, 1911), and of the choice of Paris as the "centre horaire mondial," and the transmission of time by the wireless installation of the Eiffel Tower. A committee has been formed, and it is proposed to set up the monument at Villers-sur-Mer, a spot where the Greenwich meridian cuts France; this position has been accurately determined by the military geographical service.

"L'Astronomie" for January.—In the first issue of *L'Astronomie* for the current year it is announced that the council of the Astronomical Society of France has decided further to enhance the value of this very excellent journal by increasing the number of illustrations and their scientific and artistic interest; moreover, the number of pages of text will be also augmented. Another new feature will be the publication in the journal every three months of a new series of celestial charts, drawn especially by M. G. Blum, giving the aspect of the southern hemisphere sky. The first of these charts is printed in the present number. The new form of illustration is also depicted, and shows striking reproductions of numerous images of the planet Saturn, so successfully photographed by Prof. Barnard in 1911 with the large Mount Wilson reflector. This issue contains also much interesting matter. Thus an account with illustrations is given of the large fall of meteorites at Aztec, in Arizona, which took place on July 19, 1912. M. Camille Flammarion gives an excellent summary of the magnetic communication between the sun and earth, while the concluding article on stellar photometry is contributed by M. Jules Baillaud. Observers of Mars will be interested in the abnormal feature on this planet's surface observed by M. Fournier in October and December, 1911, in the Lybian and Arcadian regions.

INTERNATIONAL CONFERENCE ON THE SAFETY OF LIFE AT SEA.

THE International Conference on the Safety of Life at Sea, first suggested by the German Emperor and convened by the British Government, has now held its final meeting. As a result of its labours, a very important convention has been signed by plenipotentiaries of the following States:—The British Empire, including Australia, Canada, and New Zealand, which were represented separately, Germany, France, the United States, Austria-Hungary, Italy, Spain, Sweden, Norway, Holland, Belgium, and Denmark. The text of the convention will not be published until February 15, but the chairman of the conference, Lord Mersey, has outlined its principal points in a speech moving its acceptance by the delegates. The convention must be ratified by the different States prior to December 31, 1914, and comes into force on July 1, 1915.

An international service is to be established and placed under the control of the United States for the purpose of ice patrol and observation and for the destruction of derelicts in the North Atlantic. The masters of all vessels are to cooperate with this service. Safety of construction has been dealt with under the headings of "New Vessels," and "Existing Vessels." The convention provides that the degree of safety shall increase in a regular and continuous manner with the length of the vessel, and that vessels shall be as efficiently subdivided as is possible having regard to the nature of the services for which they are intended.

The convention provides that all merchant vessels of the contracting States when engaged upon international (including Colonial) voyages, whether steamers or sailing vessels, and whether they carry passengers or not must be equipped with wireless telegraphy apparatus if they have on board fifty persons or more (except where the number is exceptionally and temporarily increased to fifty or more owing to causes beyond the master's control). There are certain exemptions to this regulation. A continuous watch for wireless telegraphy purposes is to be kept by all vessels required to be fitted with wireless apparatus, as soon as the Government of the State to which the vessels belong is satisfied that such watch will be useful for the purpose of saving life at sea. Meanwhile certain classes of vessels are specified as being required to maintain a continuous watch. The wireless installations must have a range of at least 100 miles. A transition period is provided to enable wireless apparatus to be fitted and operators and watchers obtained.

The convention lays it down that there must be accommodation in lifeboats or their equivalents for all persons on board, and that as large a number as possible of the boats and rafts must be capable of being launched on either side of the ship, so that as few as possible need be launched on the weatherside. The convention specifies a minimum number of members of the crew competent to handle the boats and rafts. All ships are to have an adequate system of lighting, so that in an emergency the passengers may easily find their way to the exits from the interior of the ship.

Ships of the contracting States which comply with the requirements of the convention are to have furnished to them certificates of the fact, which are to be accepted by all the States as having the same value as the certificates issued by them to their own ships.

RECENT TEMPERATURES IN EUROPE.

SEVERAL features of especial interest were associated with the recent cold spell of weather experienced over the central and southern parts of western Europe. It is common enough in January for lower temperatures to prevail over Germany than in England, but in the coastal regions of the south of France the normal temperatures at this season of the year are warmer than in the British Isles. The temperatures taken from the Daily Weather Report of the Meteorological Office show that for the twelve days January 12–23, which approximately comprise the cold spell, the mean temperature in London was 34°, the mean of the maxima being 36°, and of the minima 32°. At Biarritz the mean for the whole period was 33·5°, the mean of the maxima 38°, and the mean of the minima 29°; nine nights out of the twelve were colder than in London; the lowest temperatures were 21° on January 16, and 22° on January 15, whilst in London the lowest temperature in the twelve days was 24° on January 23. The mean temperature at Perpignan for the period was 34·5°, the mean of the maxima 40°, and of the minima 29°, the latter being 3° colder than in London, and nine nights had lower minima; the lowest readings were 22° on January 20 and 22. At Nice the mean was 40·5°, the mean of the maxima 47°, and of the minima 34°; frost occurred on the three consecutive nights, January 14–16. Paris had the mean temperature 24·5°, the mean of the maxima 30°, and the mean of the minima 19°; January 20 was the only day with the maximum above the freezing point. Much snow also occurred with the cold in parts of France. The cold spell was due to a region of high barometer readings, which maintained a position between the British Isles, Denmark, and the north of Germany, and caused a flow of air over Germany and France from the colder regions of Russia. The Daily Weather Report on January 23 shows that at 7 a.m. the temperature was 50° at Seydisfjord in Iceland, which was the same as at Lisbon, and with this exception was warmer than any other station given for western Europe. Seydisfjord was 25° warmer than London, 36° warmer than Paris, and 14° warmer than Nice. The southerly current of air which caused the anomaly was doubtless associated with the same disturbance which occasioned the rapid rise of temperature and thaw over the British Isles.

THE IMPORTATION OF BIRDS' PLUMAGE.

AS is now well known, the United States Government has made the importation of birds' plumage penal, as well as prohibited the wearing of feathers. Austria and Germany are in accord with England as to the necessity of putting a stop to this nefarious traffic by similar laws. France and Belgium stand on the other side, for the plumassiers are so influential that it is hopeless for the Government of either of these countries even to propose such a protective Bill. The French plumassiers, however, now very uneasy at the trend of popular opinion in Europe and America, have attempted to ward off the severe blow which their trade would suffer if the Société d'Acclimatation were to sympathise with the movement, by securing their admission, in considerable numbers, to the membership of both that society and the Ligue Française pour la Protection des Oiseaux. Successful so far, they next brought forward a project before the former society for the appointment of a "comité d'ornithologie economique," similar to the one in England, with the avowed purpose of inquiring into the mass of evidence as to the destruction of birds brought before the English Parliament and the U.S. Congress, but the real object of which is the hope of checking the growing force of opinion against them on this question. It will be a matter of great satisfaction to all in sympathy with the movement in this country to learn that, at a meeting held in Paris on December 24, the ornithological section of the Acclimatisation Society of France, after giving careful and prolonged hearing to the plumassiers, were constrained to record that the arguments adduced before them were unable to modify the opinions hitherto held by bird protectors with regard to the plumage trade. Notwithstanding fierce opposition and grave discord raised by the plumassiers, the project for a committee was rejected, as no benefit from it could accrue to the protection of birds. The society declared also its conviction that the depositions which have led to the prohibition of the importation of birds' plumage to the United States are unimpeachable and trustworthy.

GEOLOGY IN NORTH AMERICA.

THE Geological Survey Branch of the Department of Mines of Canada continues to cover a wide field of research. Even its "Summary Report" for 1911 includes topographic and structural papers, in which coal-mining areas are dealt with, as well as notes on peat and clay, and (p. 316) on petroleum in New Brunswick. J. W. Goldthwait's paper (p. 296) on post-glacial changes of level in Quebec and New Brunswick continues work previously published (Mem. 10) on the shore-lines of the extinct lakes Algonquin and Nipissing in south-west Ontario. In this earlier memoir the author draws isobases across the Great Lake region, showing the warping of the beaches of Lake Algonquin and its successor, the greater uplift being in both cases in the north.

M. E. Wilson, in a publication numbered 1064, describes country on the east side of Lake Timiskaming, Quebec, where for the most part pre-Cambrian rocks prevail. The relations of the fragmental Huronians to the older granites are described. A large colour-printed map (18A), on the scale of one inch to one mile, has been issued of the mining region round the lake, and includes on the west the interesting basic igneous rocks and green schists of Cobalt.

M. E. Wilson, in Memoir 17E, shows how the geological surveyor is quickly following the extension of the railway into the gold-bearing region of northern Ontario.

G. S. Malloch, in Memoir 9E, describes the Bighorn Coal Basin of Alberta, where a large area of undeveloped coal exists in Upper Jurassic or Lower Cretaceous strata. The region lies near the United States border, and is so far only accessible by horse-trails.

Memoir 27 (1912) is concerned with a serious report on Turtle Mountain, which rises above the town of Frank, Alberta. This limestone mass is tunnelled into at the base for coal, and a destructive landslide occurred in 1903. R. A. Daly, W. G. Miller, and G. S. Rice, the commissioners appointed, now show that great fissures traverse the upper portion of the mountain, and that the modern forest growth is affected by their widening. The illustrations, especially plate viii., record impressive instances of the creep of massive rocks. It is recommended that the town of Frank, at the foot of the great scarp, should be moved to another site in the valley, since the mountain is structurally unsafe, irrespective of its possible weakening by the mines.

In Memoir 13 (1912), C. H. Clapp describes the mountainous region of southern Vancouver Island. A recent uplift of some 250 ft. has taken place (p. 13), whereby the coast-features have become rejuvenated, and the streams now fall from upraised coastal plains over rock-cliffs into the ocean. The prospects of copper-mining are discussed, but pyrite and pyrrhotine are the most prevalent ores. The metallic veins arose (p. 173) in connection with igneous intrusions of Upper Jurassic and Lower Cretaceous age.

W. H. Twenhofel, of Yale University (*Am. Journ. Sci.*, vol. xxxiii., 1912, p. 1), summarises the physiography of Newfoundland, in a paper that will interest geographers. Fault-scarp features remain prominent on the Long Range in the south-west of the island, and the faulting is later than the formation of a peneplain, which is tentatively correlated (p. 19) with the late Cretaceous peneplain of the Appalachians.

In Memoir 21 (1912) of the Canadian Geological Survey, on the geology and ore deposits of Phœnix, B.C., O. E. Le Roy makes some interesting observations on the silicification of large bodies of limestone, whereby nodular "jasperoids" are produced (p. 34).

Memoir 16E, on the clay and shale deposits of Nova Scotia and portions of New Brunswick, by H. Ries and J. Keele, and Memoir 24E, by the same authors, on the clay and shale deposits of the western provinces, both contain (pp. 115 and 177) a useful general essay on clay-rocks and their impurities. H. S. de Schmid has similarly incorporated a broad review of the mica industry throughout the world in his memoir on mica (Department of Mines, Mines Branch, 1912). The development of the "mica-board" trade now allows of the use of material that formerly was thrown aside.

In a monograph of 200 pages on pyrites in Canada (Mines Branch, 1912), A. W. G. Wilson describes the uses of iron sulphides, and the processes employed in roasting and in the manufacture of sulphuric acid.

The Mines Branch has also issued vol. i. (376 pp.) of a "Report on the Building and Ornamental Stones of Canada," by W. A. Parks, in which technical questions are prominent; and numerous papers on applied mineralogy appear in the "Summary Report" for the year 1911, including an account (p. 103) of the use of magnetic observations in tracing pyrrhotine. Pyrrhotine in Canada, of course, to the miner implies pentlandite and nickel.

L. M. Lambe, of the Geological Survey of Canada, has reviewed the past vertebrate life of Canada (Trans. R. Soc. Canada, vol. v., 1911, ser. 3, p. 3). Due prominence is given to the deinosaurs of the Judith River beds.

O. P. Hay, in a paper on the recognition of Pleistocene faunas (Smithsonian Miscell. Collections, vol. lix., No. 20, 1912), shows, in a series of maps, the distribution of a number of mammals in North America since the Pliocene period. The limit set by the fluctuating ice-margin in the north is clearly seen; but the author regards temperature-changes as of far less importance in promoting changes in the fauna than the mere element of time, whereby one type of mammalian fauna disappeared before another, which was itself already doomed to disappear. We presume that the doom thus referred to implies some cause other than the mere decay of specific energy during time; but this question trenches on physiology.

The work of the United States Geological Survey, equally with that of Canada, maintains a broad outlook, from topography to mineral research. The succession of severe earthquakes that occurred in the central Mississippi Valley in 1811–12, when the region was thinly populated, has been investigated by M. L. Fuller (Bull. 494, 1912). The possibilities of recurrence are considered (p. 110). Interesting surface-features due to the sudden extrusion of sand from fissures still indicate the earthquake-area, and a large region of sunken land is marked by stumps of trees standing in water, as was noted by Lyell in 1846 (p. 70).

The second edition of F. W. Clarke's "Data of Geochemistry" (Bull. 491, 1911) now takes the place of the copies of this manual that have been used with such advantage in scientific libraries. Its 731 pages form a summary of the chemistry of the earth, with abundant references to sources of information. The origins of minerals and rocks are steadily borne in mind, and the results of the evolution of gases from the earth, of processes of subaërial weathering, and of the multiplication of marine organisms in the ocean, are alike brought under review. The work, indeed, is for the general geologist quite as much as for the specialist in petrology. The passages on aragonite and calcite, on laterite, and on dolomitic limestone may serve as good examples. Nearly a hundred pages, moreover, are devoted to the origins of metallic ores.

T. N. Dale and H. E. Gregory (Bull. 484) describe the granites of Connecticut, with remarks (p. 17) on the composite origin of some of the associated gneisses. As is usual in such memoirs, examples are given of the monumental use of the quarried stones.

T. N. Dale also reports on the marbles of Vermont (Bull. 521), in which graphitic bands are ascribed to marine algæ of Ordovician age.

Bull. 492, by G. F. Loughlin (1912), contains some interesting examples of the effects of dynamic metamorphism upon gabbro in Connecticut, well illustrated in plates x. and xi.

C. W. Hayes and W. Lindgren edit the report on the developments in economic geology during 1910 (Bull. 470, 1911). Considerable attention is given (pp. 371–483) to the oolitic phosphate beds of Idaho, Montana, and Wyoming. R. W. Richards and G. R. Mansfield (p. 377) hope to show later that the Upper Carboniferous phosphatic deposits of Idaho were formed at a time of abnormal enrichment of the sea-water with phosphoric acid or its salts, and not by subsequent infiltration. In Bulletin 471, M. R. Campbell continues this report by an extensive review of mineral oils, coals, and lignites in many districts now under exploration. W. T. Lee (Bull. 510) has explored the area of Cretaceous coals in north-west Colorado. These coals have been improved in calorific value by the influence of quartz-monzonite laccolitic intrusions, which are clearly shown in the published sections.

H. S. Gale (Bull. 523) reviews the nitrate deposits of the United States, none of which seem at present to be of commercial value. The sketch of the origin of nitrates in soils (pp. 31–5) is just what teachers of mineralogy and agriculture require.

The demands of agriculturists are further considered in Bulletins 511 and 512. The former, by B. S. Butler and H. S. Gale, deals with a newly found deposit of alunite in Utah, which is believed (p. 36) to result from the uprising of solutions from below. The mineral occurs in veins in andesite, the main one being 20 ft. thick. The purity of the mass is shown by analyses which yield respectively 10·46 and 9·71 per cent. of potash. Alunite may be converted into a soluble sulphate by calcination, and a useful review is given of its commercial use in Australia and other places. In Bulletin 512, A. R. Schultz and Whitman Cross, with a somewhat prophetic outlook, consider the future of the potash-bearing rocks of the leucite hills in Wyoming. The percentage of potash in these lavas is about the same as that in alunite, and may reach even 12 per cent. The greater portion of the potash occurs in the two minerals leucite and phlogopite, and the authors look forward to the possibility of the separation of these minerals and the extraction of potash and alumina from them, or even from the lavas as a whole. The estimate of the alumina available in millions of tons (p. 35) seems premature, and any commercial process that may be devised will probably, so far as this substance is concerned, be applied also to common clay.

FIG. 1.—Rock-glacier on McCarthy Creek, Nizina district, Alaska. From Bull. 448, U.S. Geol. Survey.

Petrographers as well as miners will find much of interest in Professional Paper 77, on the Park City District, Utah, by J. M. Boutwell. A novel and effective feature is the illustration of the ores and associated rocks by photographs taken in the tunnels of the mines.

Mining districts in a hitherto unmapped region in Elko County, Nevada, are described by F. C. Schrader in Bull. 497 (1912). The gold ores of Jarbridge, which are here beautifully illustrated, are attributed (p. 63) to the rise of waters at a high temperature, following on the eruption of Miocene rhyolites. The metallic ores are sometimes referred to as "mineral" and sometimes as "metal values," terms which seem out of place in a scientific treatise. A. Knopf (Bull. 504, 1912) describes briefly the Sitka mining district, Alaska, where gold in quartz reefs and gypsum are the valuable materials. The gold, as well as certain copper ores, is regarded (p. 17) as connected with the uprise of intrusive diorite.

F. H. Moffit and S. R. Capps (Bull. 448, 1911) show very interestingly how slowly moving rock-glaciers succeed true glaciers where warmer conditions now prevail in Alaska. Snow-slides, of course, assist in moving the material, but rock undoubtedly now predominates in the flow. The illustration here reproduced (Fig. 1) is one of several instructive plates. Gold is now the main product of the Nizina district, though chalcosine and native copper offer attractions.

Alaska claims continued notice. Bulletin 485, by G. C. Martin and F. J. Katz, describes the Iliamna region, where Triassic cherts are associated, as seems almost inevitable, with "green rocks" of volcanic origin. The same authors, in Bulletin 500, deal with the coal-bearing Lower Matanuska Valley, above Cook Inlet in lat. 62°. The coals are in Cainozoic strata, and are probably of Eocene age (p. 52). Basic lavas have intruded through these beds, and form conspicuous features on the bare hillsides (Fig. 2).

The development of Alaskan areas is also seen in Bulletins 449, 498, and 502. In Bulletin 467 (1911), W. W. Attwood deals with the coals and possible gold ores of the Alaska Peninsula, and furnishes several very interesting photographs of the coast. Bulletin 520, by a number of authors, brings our knowledge of the mineral resources of Alaska up to date. The review (pp. 45–88) of the possibilities of railway construction between the Pacific coast and the interior is of special interest, and the sketch-map provided, with "coal reported" marked on the seaboard of the north-east passage, is the sort of thing to captivate a Frobisher or a Cabot. The Cainozoic coal of the Bonnifield region is reported on in Bulletin 501, which also contains interesting notes on glaciation. Other economic papers on Alaska have been already noticed in NATURE (vol. xc., 1913, p. 659).

Professional Paper 71 (1912), constituting a large memoir on the stratigraphy of North America, by Bailey Willis, and accompanied by a coloured geological map of North America, on the scale of 1 : 5,000,000, is of such wide educational importance that it has already received special mention (NATURE, vol. xci., p. 93). Changes in nomenclature are somewhat rapid in the United States, and, since this great index was published, C. D. Walcott (Smithsonian Miscell. Collections, vol. lvii., No. 70, September, 1912) gives reasons for withdrawing his terms Georgian for Lower Cambrian and Saratogian for Upper Cambrian, and replacing them by Waucoban and St. Croixan respectively. Both these new names offer puzzles in pronunciation for the stranger. "St. Croixan" was first published by Walcott as a stratigraphical term in the preceding number of the Collections, p. 257, in which some very interesting tracks of Upper Cambrian trilobites are illustrated.

FIG. 2.—Diabase dyke in fault-plane in Cainozoic (Chickaloon Coal-measure) strata, Castle Mountain, Alaska. From Bull. 500, U.S. Geol. Survey.

Four of the recent Professional Papers deal with western districts. No. 70, by A. H. Brooks, describes the difficult survey of the Mount McKinley region in Alaska in 1902, where almost all the geological systems are represented. From the historical summary on pp. 29–32, it seems doubtful if any explorers had reached the summit of Mount McKinley (20,300 ft.) by the close of 1910. The decay of the upland is shown by the immense areas of post-Pliocene detritus recorded on the preliminary geological map. The maps add considerably to our knowledge of the topography of the divide between Cook Inlet and the Yukon system.

In No. 73 W. Lindgren discusses the Tertiary gravels of the Sierra Nevada of California, well known as the scene of hydraulic gold-mining. The Great Valley of California has received detritus from the rising continental land ever since the opening of Cretaceous times, the shore-gravels becoming purely fluviatile during the Pliocene period (p. 28). J. M. Boutwell (p. 54) has had an opportunity of resifting the first-hand evidence as to the antiquity of the Calaveras skull, which at one time obtained a celebrity akin to that of the bones—also from Calaveras—which "were found within a tunnel near the tenement of Jones."

Professional Paper 74, by W. H. Weed, describes the Butte District, Montana, and is bound in cloth, a mode of presentation which makes it far more convenient than most of these large and frequently consulted volumes. The Big Butte is a conspicuous rhyolitic hill rising above a somewhat dreary country of quartz-monzonite and andesite. The bare surface, however, allows the mineral veins to be traced over wide areas, and the district is now second only to the South African Rand as a producer of metals. The main ores are those of copper, containing 14 per cent. of silver. The volume includes a large number of vein-plans, and illustrations of the connection between separation-planes and ore-deposits in the crystalline igneous rocks. The ores were accumulated in these fundamental masses at some epoch prior to the eruption of the volcanic rocks at the close of the Cretaceous period. The conclusions as to their modes of origin may be compared with those of J. D. Irving and H. Bancroft for the district of Lake City, Colorado (Bulletin 478), where similar conditions occur.

Paper 75 is by F. L. Ransome, on the Breckenridge District, Colorado. Here gold is again the attraction, and the district has rapidly developed since 1909, when new dredges were introduced for dealing with the gravels. The glacial deposits show, as is so very general in America, two epochs of ice-advance and ice-retreat (p. 72). The fissures containing the sulphide ores and the gold from which the placer ores are derived were formed by earth-movements in early Cainozoic times.

It is impossible in a brief outline to do justice to the large volume (Monograph LII.) on the geology of the Lake Superior region, by C. R. van Hise and C. K. Leith. Much of the discussion on the pre-Cambrian series concerns the Dominion of Canada also, and miners will find a comprehensive account (pp. 460–596) of the ores of iron, copper, gold, and silver in the district. The ferruginous cherts, with hæmatite or limonite, are held to have arisen from the oxidation of cherty iron carbonates and of the green silicate greenalite, $(Fe,Mg)SiO_3.nH_2O$. The green oolitic ores with hæmatite of Dodge County, Wisconsin (pp. 567 and 536), which are regarded as having been deposited in a granular form in the sea, and the greenalite rocks of the Mesabi District (p. 165), invite comparison with the ironstones containing green oolitic grains in the Silurian rocks of North Wales (p. 509), concerning which the last word has by no means been said; while the red banded cherts remind us of similar stratified deposits in South Africa. The authors believe that the iron, whether hæmatite or magnetite, was largely introduced into the Lake Superior sediments from the adjacent basic igneous rocks, at a time when the latter were hot and capable of sending magmatic waters into the sea in which the sediments were accumulating (pp. 516 and 527).

In Bulletin 503, E. C. Harder indicates the development of the iron and steel industry on the Pacific coast of California.

Bulletin 505 (1911), by A. C. Veatch, is a summary of the mining laws of Australia and New Zealand, with testimony by practical miners as to their operation. The material of the bulletin was brought together for a report to Congress, to assist in framing regulations for granting leases of public coal-lands in the United States.

The Geological Survey of Alabama, working in cooperation with that of the United States, reports (Bulletin No. 10) on the Fayette Gas Field in the north-west of the State, where gas rises freely from small "gas-pools" in a coalfield of Upper Carboniferous age. Further explorations are recommended. The development of roads throughout Alabama by the use of selected material is discussed by W. F. Prouty in Bulletin No. 11, and there seems evidence that the lesson taught to Europe by the Romans, and long neglected by their successors, is at last spreading in the United States. It will be many years, however, before these civilised communities will possess the advantages given by French rule to the Berbers of North Africa.

The Wisconsin Geological and Natural History Survey issues (1912) a neat volume on the sandstones of Lake Superior, by F. T. Thwaites. The Bayfield group is the centre of interest, and is placed (p. 104) below the Cambrian, representing a sandy terminal phase of the Keweenawan sediments, in a region where a basin had been established which became choked by alluvial fans from the surrounding hills. The Survey also issues a large geological wall-map of the whole State, with a view to the requirements of public education.

In continuation of its handsome series of cloth-bound volumes, the Maryland Geological Survey publishes a work by W. B. Clark (State geologist), A. B. Bibbins, E. W. Berry, and R. Swann Lull, on the Lower Cretaceous deposits of the State. Mr. Berry (p. 99) takes the opportunity to summarise, with specific lists, the Lower Cretaceous floras of the world. As regards British deposits, he points out that we are not yet in possession of all that may be expected from the work of Dr. Stopes. Vol. ix. of the reports of the Survey treats largely of highway construction, but includes a history and description of the iron industry in the State. Prince George's County has been described in the latest of the interesting county monographs, with complete topographical and geological maps on the scale of one inch to one mile. We can imagine nothing better for the information of teachers in the local public schools.

The Iowa Geological Survey, in a massive volume issued at the close of 1912, includes its annual reports and papers for 1910 and 1911. More than 1100 pages are devoted to a thorough study of the underground waters of the State, including (p. 268) several mineral springs.

In *The American Journal of Science*, vol. xxxv. (1913), p. 1, J. W. Goldthwait, whose Canadian work has been already mentioned, describes cirques in New England, which, as seems natural, were occupied by small glaciers both before and after the great extension of continental ice. On p. 139, F. A. Perret carries us to "The Lava Fountains of Kilauea," which may now be fairly styled American. The mobility of the lava is ascribed (p. 143) to its being highly charged with an inflammable gas. The blue, and therefore highly actinic, cloud due to the combustion of this gas is here shown in photographs. It is well to learn, in view of the great interest aroused by Brun's researches, that the evolved gases are being carefully studied on the spot. The author regards those emerging from a lava-surface, that is, from a mass subject to oxidation, as quite distinct from the far purer gas of a great paroxysmal eruption. We must admit, in spite of all the work done on fumeroles, that we are still on the verge of this great question. In the same volume of the journal, p. 611, Mr. Perret directs attention to the evidences of occasional explosive action during the past history of Kilauea.

RÖMER'S "ADVERSARIA."

"ETUDES sur les notes astronomiques contenues dans les Adversaria d'Ole Römer," is the title of a paper by G. van Biesbroek and A. Tiberghien, published in the Bulletin of the Royal Danish Academy of Sciences (112 pp.). The "Adversaria" were published in 1910, and were reviewed in Nature (vol. lxxxvi., p. 4). The authors of the present paper give a detailed analysis of most of the astronomical notes contained in the volume. This analysis is especially valuable on account of the way in which the astronomical notes in the "Adversaria" are mixed up with others on hydraulics, statics, the construction of thermometers (the scale known as Fahrenheit's is due to Römer), numismatics, &c. These notes all date from the last eight years of Römer's life (1702–10), although several refer to investigations made during his stay in Paris (1672–81).

The authors dwell particularly on the various discussions of the work done from 1704 in Römer's private observatory a few miles west of Copenhagen, which show him as a great practical astronomer, to whom the principal modern instruments of precision and methods of observing are due. Thus it is shown that it was Römer, and not his pupil Horrebow, who invented the method of determining latitudes by altitudes observed north and south of the zenith and nearly at the same time, now known as the Horrebow-Talcott method. In this the result is independent of refraction, and a micrometric measure takes the place of the reading of graduated circles. Horrebow has certainly the merit of having recognised and published the advantages of the method, but there is now no longer any doubt that the idea was due to Römer.

At the beginning of the eighteenth century the method of determining time by observing equal altitudes of the sun east and west of the meridian was still in general use. Römer constructed an instrument for this purpose, in which the telescope was attached to a bar suspended vertically from a crook at the upper end, and he prepared tables and formulæ for reducing the observations. By degrees the use of the transit instrument, as regards which he was himself the pioneer, superseded the observations of equal altitudes in fixed observatories.

Römer also examined the problem of time-determination in the vertical of the pole-star; he did not arrive at a simple solution, but tried to get over the difficulty by constructing extensive tables for twenty-seven selected stars. How much he was in advance of his time is shown by his having employed the formula for correcting transit observations for instrumental errors proposed fifty years later by Tobias Mayer. The transit instrument in the prime vertical, introduced by Römer, was employed by him to determine the time of the equinoxes by a method which was a modification of one which he had described to the Paris Academy in 1675, but which, like most of his other investigations, never was published.

The authors give a detailed examination of his preparations for determining the vernal equinox of 1702 by this method. In the original method (described by Horrebow) the declination of the sun at its upper or lower meridian transit was deduced from the intervals of time between the transits over verticals near the prime vertical, employing an approximate value of the latitude of the place of observation. In the method of 1702 the declination of the sun does not enter, nor the latitude. The principal reason why Römer wished to eliminate the latitude, was, that he, like Picard, thought it was subject to an annual variation. Without knowing it, these two eminent practical astronomers had, in fact, perceived the effect both of aberration and of nutation on the apparent place of the pole star. Römer's method of determining the equinoxes is more ingenious than useful, since it not only assumes that the clock rate and instrumental errors do not change, but also requires that the sky should be clear for at least three consecutive approaches of the sun to the prime vertical as well as for time determinations.

It might have been expected that the man who had discovered the gradual propagation of light, and even foreseen the existence of aberration as its necessary consequence, would in his private notebook have left evidence that he continued to be interested in the discovery. There is, however, only an examination of the question, whether it would be possible to determine the velocity of light by means of lunar eclipses. He found, of course (as he had already done in 1677), that the velocity is far too great to become perceptible in observations of that kind.

Römer was the only observer who succeeded in seeing Mercury on the sun's disc on May 6, 1707, just after sunrise; the authors have computed the particulars of the transit by Newcomb's tables, and find that the observation agrees perfectly with modern theory. The doubts thrown on Römer's observation by Halley and Baily have thus been shown to be baseless, while Sharp's supposed observation must be rejected altogether. There are many other points of interest in this paper, which it is to be hoped will become widely known, as it gives a valuable survey of the varied activity of a man, who but for his reluctance to put his researches into shape and publish them would be reckoned among the greatest astronomers.

J. L. E. D.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. D. G. Reid has been appointed junior demonstrator of human anatomy for five years in succession to Dr. Rogers, who has resigned the office.

The prize of 50*l*. from the Gordon Wigan Fund for a research in chemistry was awarded in the year 1913 to Mr. H. V. Thompson, for investigations on "Some Reactions of Diiodoacetylene," "Acetylenic Carbon," and "The Molecular Weight of Cellulose."

To the detailed report on the work of the score of men who have held John Lucas Walker studentships at Cambridge University, which occupies many pages in the present number of *The Cambridge Reporter*, the governors of the trust have added these words:—"During the twenty-seven years since the John Lucas Walker studentship, one of the earliest studentships in pathology, was established, the candidate who appeared most likely to carry out pathological investigations successfully, whether a Cambridge graduate or from some other school, British and Colonial, has always been appointed. While the work accomplished by the later holders of this studentship is perhaps too recent to be appraised, there has been ample time for that accomplished by the earlier students to manifest its worth and influence, not only upon the future careers of the students and upon the Cambridge Medical School, but upon the science of medicine. Moreover, it is now possible to form a fair estimate of the value of this foundation in particular and of graduate research studentships or fellowships in pathology in general. It would be difficult to cite any one position within the Empire which, in the same period, has been occupied by a succession of men so able, and who have attained such eminence in medical research."

LEEDS.—Mr. Henry Rutson, of Newby Wiske, Northallerton, has made a donation of 500*l*. to the funds of the University. It is only a short time since Mr. Rutson made a similar donation to the fund for new agricultural buildings.

Mr. Godfrey Bingley, an accomplished photographer, who has been connected for many years with the Leeds and Yorkshire Geological Association, has presented a collection of lantern slides, illustrating architecture, archæology, geology, and scenery in all parts of England, but especially in Yorkshire. There are about ten thousand slides of exquisite workmanship, and the collection is admirably arranged and catalogued. The section which deals with the geological and geographical aspects of Yorkshire is believed to be unequalled.

An anonymous donor has presented the sum of 20*l.* to be used for the purchase of a unique collection of fossils from the Marine Bands of the Coal Measures of Yorkshire, made by the late Mr. Henry Culpin, of Doncaster. The University has also received the conchological collections and library of the late Mr. William Nelson. Mr. Nelson was a working man who accumulated a collection of land and fresh-water shells of extraordinary variety and great interest. On his death a memorial committee was formed to acquire his collection and library, which will now be handed to the zoological department of the University, where they will be a valuable addition to the resources for zoological research.

OXFORD.—On Tuesday, January 27, Convocation passed a decree giving the consent of the University to the establishment of three professorships, in anatomy, chemistry, and experimental philosophy. These will be styled Lee's professorships, and the provisions relating to them "will not come into effect until there is a vacancy in the existing Lee's readerships in the three subjects respectively." The readership in chemistry is now vacant. The holder of each of the first two professorships will receive 900*l.* from Christ Church annually; the holder of the last-named will receive the same amount, provided mainly by Christ Church, but partly from other sources, including a grant from Wadham College. The Lee's professorship in chemistry will be an actual addition to the present staff; the other two will be ultimately merged in the existing professorships of human anatomy and experimental philosophy. Christ Church will retain the power of appointing Lee's readers in anatomy, chemistry, and physics, in addition to finding nearly the whole emolument of the Lee's professorships. It is to be hoped that the University funds set free by the action of Christ Church will continue to be applied to scientific objects.

Congregation has made some progress in the amendment stage of the statute proposing extensive changes in Responsions, but it is doubtful whether the statute will reach a final reading.

THE December number of *The Central*, the journal of the old students of the Central Technical College, South Kensington, continues to display those features which make it one of the best of the old students' magazines. Of the scientific article and the technical articles on chemical and electrical subjects respectively, little need be said, as they do not differ materially from corresponding articles which might be found in the technical Press. The article on "Ambitions—Commercial v. Technical," by a young sales manager, is well worth the careful consideration of technical students. It puts very clearly the advantages of a commercial career for those who have any doubts as to their capabilities as constructional engineers. The problems which confront a commercial engineer are as interesting, and may often be solved by the same methods as those a technical engineer encounters, while the rewards of success are both larger and come more swiftly. The rest of the number is devoted to the events of the past session, including changes in the staff, with photographs and views of the new buildings, and to the changes of positions of a large number of old students. It is the last characteristic which makes the journal so invaluable to all old Centralians.

A SHORT account of the work and objects of the Sutherland Technical School, built several years ago by the late Duke of Sutherland and Mr. Andrew Carnegie, near Golspie, in Sutherland, is given in the issue of *The Times* for January 23. In a letter to *The Times* of January 26, the Duchess of Sutherland makes an appeal for 20,000*l.* as a partial endowment for the school, and points out that 10,000*l.* has been raised among a few of her friends, and that it should not be difficult to secure the remainder. The aim of the school is to give boys from the small farms and fishing villages of the Highlands an opportunity to continue their school life in conditions which shall enable them to develop their special aptitudes and to learn the essentials of appropriate industries. The pupils are drawn from primary schools, and begin the course at the age of thirteen. The boarding-house attached to the school has room for forty-eight boys, and bursaries are provided to the number of forty. The secretary of the Scotch Education Department has spoken of the school as one of the most interesting educational experiments in recent times in Scotland. This successful attempt to provide a much-needed link between schooldays and the years of wage-earning is, in fact, worth the study of those education authorities now contemplating the inauguration of junior technical schools in rural districts.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 22.—Sir William Crookes, O.M., president, in the chair.—Dr. R. T. **Glazebrook** and D. W. **Dye**: The heat production associated with muscular work: a note on Prof. J. S. Macdonald's paper, Proc. R.S., B, vol. lxxxvii. Prof. Macdonald's results are analysed graphically by plotting, equations being obtained from curves connecting the various quantities—heat produced, work done, mass of individual.—M. **Wheldale** and H. L. **Bassett**: The chemical interpretation of some Mendelian factors for flower colour. These researches deal with the Mendelian factors for flower-colour in varieties of *Antirrhinum majus*. Two varieties, ivory and yellow, are chiefly considered. Ivory is a simple Mendelian dominant to yellow and contains a factor "I," which is absent from yellow. The authors have previously identified the pale yellow pigment of the ivory variety with a flavone, *i.e.* apigenin. In the present paper it is shown that the yellow variety contains, in addition to apigenin, another flavone pigment, *i.e.*, luteolin, which is present in the epidermis and accounts for the deeper yellow colour of the flower. Hence the dominant ivory factor may be expressed as the power to inhibit the formation of luteolin in the epidermis.—Prof. G. **Dreyer** and Dr. E. W. A. **Walker**: The determination of the minimum lethal dose of various toxic substances and its relationship to the body weight in warm-blooded animals, together with considerations bearing on the dosage of drugs. In warm-blooded animals of some species but different weights, dosage must be calculated in relation to body surface.—Prof. R. **Kennedy**: Experiments on the restoration of paralysed muscles by means of nerve anastomosis. Part ii., Anastomosis of the nerves supplying limb muscles.—Dr. F. Norman **White**: Variations in the sex ratio of *Mus Rattus* following an unusual mortality of adult females.

Geological Society, January 7.—Dr. Aubrey Strahan, president, in the chair.—C. I. **Gardiner** and Prof. S. H. **Reynolds**: The Ordovician and Silurian rocks of the Lough Nafooey area (county Galway). The Lough Nafooey area forms a ridge about four miles long and slopes steeply down to Lough Nafooey on the north. The rocks are of Arenig, Llandeilo, and Silurian age, together with intrusive felsites, bostonites, labradoriteporphyrites, and dolerite. The Llandeilo rocks are mainly confined to the low-lying ground along the shore of Lough Nafooey, and have yielded no fossils. They dip at a high angle off the Arenig rocks, which extend in a band from a third to half a mile wide from end to end of the area. The Arenig rocks consist of spilite-lavas associated with coarse breccias, and with bands and patches of chert in which at two points radiolaria were found. Unfortunately, no graptolites were found in the Arenig rocks. Silurian rocks form the whole southern half of the area. They are highly inclined. They include representatives of the Llandovery, Tarannon, and Wenlock formations. The occurrence of *Monograptus galaensis* confirms the field evidence as to the Tarannon age of certain grey flags. The Wenlock beds are represented by thick grits. The paper concludes with a table comparing the rocks of the Lough Nafooey area, with those of Kilbride and those of the Killary district.—T. C. **Nicholas**: The geology of the St. Tudwal's Peninsula (Carnarvonshire). The St. Tudwal's Peninsula is situated at the S.E. extremity of S.W. Carnarvonshire, and forms the N.W. limit of Cardigan Bay; it is underlain by Cambrian and Ordovician rocks. In the southern part of the peninsula the structure is simple, and the succession plainly displayed in cliff-sections; Cambrian rocks similar in character to those of Merionethshire form most of the coast, but the interior is occupied by Arenig beds, which rest with a marked unconformity on every local member of the Cambrian in turn. The latter have escaped cleavage, and mudstones in the midst of the series have yielded fossils belonging to the zone of *Paradoxides hicksi*. The *P. davidis* zone appears to be absent. This southern area is separated by an overthrust from a more northern area in which members of the Tremadoc, Arenig, and Llandeilo series have been recognised, but in which the rocks are crushed, faulted, and disturbed, and the relations between the beds are far from clear. Pisolitic iron-ore is well developed in the district, and occurs chiefly in the Llandeilo beds along the line of the overthrust. Evidence is presented to show that, during the last phase of glaciation, the ice was moving across the peninsula in a westerly direction out of Cardigan Bay.

Linnean Society January 15.—Prof. E. B. Poulton, president, in the chair.—H. A. **Baylis**: Some observations on the tentacles of *Blennius gattorugine*. A study of sections of the branched tentacles shows an abundant supply of nerves in the centre of the organs, sending off branches to their smaller twigs. The function of the tentacles is still doubtful, but so far as the evidence goes, it only proves that they are sensitive to tactile stimuli, and probably the fusiform cells are concerned in the perception of such stimuli.—G. Claridge **Druce**: A new marsh Orchis. The author proposed the name *Orchis praetermissa* for the plant which he contrasted with the true flesh-coloured *O. incarnata* of Linnæus, as described by C. B. Clarke in Journ. Linn. Soc., vol. xix. (1881), p. 206, showing how it differed in the shape of the flowers and in other characters from that plant. He has as yet been unable to see any description or figure of his plant in British or European works.

Royal Anthropological Institute, January 20.—Annual general meeting.—Prof. A. Keith, president, in the chair.—Prof. A. **Keith**: Reconstruction of human fossil skulls (presidential address). The ordinary anthropological methods employed for the examination and description of complete skulls are not applicable to fragmentary fossil skulls. During the last six years the president had endeavoured to discover and perfect methods which might be employed in the reconstruction of skulls from fragments. Recently fragments of a human skull, representative of the pieces of a fossil human skull found at Piltdown, had been submitted to him for reconstruction. A cast of the original skull was kept by those who submitted the fragments to him. There was no apparent trace on the fragments of the middle line along the vault. The reconstructed skull with a cast of the original was submitted to the meeting. Tracings of the reconstructed skull were exhibited side by side with similar tracings from the lecturer's reconstruction of the Piltdown skull to show that the problem of reconstruction was the same in each case, and that in all dimensions the cranial cavity of the Piltdown skull was larger than the test skull submitted to him.

Royal Meteorological Society, January 21.—Annual general meeting.—Mr. C. J. P. Cave, president, in the chair.—C. J. P. **Cave**: Presidential address: Upper air research. Research in the upper air may be by means of manned balloon with observer and instrument, or by self-registering instruments sent up in kite, captive balloon, or free balloon. Kites were first used for this purpose by Dr. Wilson, of Glasgow, 1749, and also in Arctic expeditions in 1821 and 1836. The box-kite and the use of steel piano wire instead of line enabled greater heights to be obtained, and both were adopted by the Blue Hill Observatory in 1895. The use of kites was not taken up in England until 1902, when Mr. Dines flew them from a steamer. After referring to the use of balloons and the ascents made by Glaisher and others, the president said that danger to life in high ascents caused MM. Hermite and Besançon to use a registering balloon in 1893; a free balloon carried a recording instrument, the recovery of the instrument being dependent on the balloon being found after its descent; a height of nine miles was reached in France and thirteen miles in Germany soon after. The International Commission for Scientific Aëronautics directs the studies for upper air research, and special days are arranged for international ascents of balloons and kites, stations in various parts of the world taking part in the work. The first great result of these researches has been the discovery that the atmosphere is divided into the troposphere, where the air is in constant movement horizontal and vertical, and the stratosphere, where turbulent motion seems to cease. The stratosphere begins at about 7·5 miles in these latitudes.

Mathematical Society, January 22.—Prof. A. E. H. Love, F.R.S., president, in the chair.—S. T. **Shovelton**: (i) A generalisation of the Euler-Maclaurin sum formulæ. (ii) The deduction of the formulæ of mechanical quadrature from the generalised Euler-Maclaurin sum formulæ.—(iii) A generalisation of certain sum formulæ in the calculus of finite difference.—Prof. A. E. H. **Love**: The potential of an electrified circular disc.—Dr. A. **Young**: Binary forms.—J. R. **Wilton**: Darboux's method of solution of partial differential equations of the second order.

DUBLIN.

Royal Irish Academy, December 8, 1913.—Count Plunkett, vice-president, in the chair.—R. **Southern**: Polychæta. Part ii., in connection with Clare Island Survey. This paper dealt with the second part of the Polychæta from the Clare Island district, and comprised the *Polychaeta sedentaria*. The number of species in this section is 105, bringing the total number of Polychæta from Clew Bay and the adjacent waters to 250. One new genus, Thelepides, is described, and eight new species, belonging to the genera Nerinides, Aonides, Chætozone (2), Protothelepus, Armandia, Chone, and Euchone.

January 12, 1914.—Rev. Dr. Mahaffy, president, in the chair.—W. J. **Lyons**: Climatology, in connection with Clare Island Survey. This report contained tables giving the annual and monthly means and extremes of barometric pressure, temperature, and rainfall for the district, together with summaries dealing with humidity and sunshine. An exhaustive analysis of the wind records kept at Clare Island Lighthouse was made, with some interesting results.

Paris.

Academy of Sciences, January 19.—M. P. Appell in the chair.—H. **Deslandres** and L. **d'Azambuja**: The exact study of the second group of nitrogen bands in the magnetic field. Recognition of the nature of the displacements. The experiments were carried out in a magnetic field of 35,000 Gauss. The deviations, for λ about 400, corresponded to a maximum of 1·40 mm. for one Angström. Four diagrams are given showing the changes observed in different portions of the band N 25,009.—Armand **Gautier**: The function and state of fluorine in the animal economy. A discussion of the relations existing between phosphorus and fluorine in animal tissues.—M. Charles **Richet** was elected a member in the section of medicine and surgery in succession to the late M. Lucas-Championnière.—Charles **Arnaud**: Astronomical refraction. A simplification of some approximate formulæ given in a preceding communication.—Victor **Vâlcovici**: Fluid movements with constant vortex.—G. **Lumet**: Testing lubricating oils for internal-combustion motors. An attempt to test the viscosity of oils under conditions approximating to those actually existing in the cylinder of an explosion motor.—Georges A. Le **Roy**: Magnification or reduction of phonograms. A gelatine cast is taken of the original phonogram, and this is enlarged by hydration and reduced by drying, with fixation in each case by aqueous solutions of formaldehyde.—M. de **Broglie**: The spectroscopy of the Röntgen rays. Five photographic reproductions accompany the paper.—M. de **Broglie** and F. A. **Lindemann**: Fluoroscopic observation by direct vision of the spectra of the Röntgen rays.—Victor **Henri** and Marc **Landau**: The application of spectroscopy to the study of chemical equilibria. The systems formed by oxalic acid and uranyl salts. A mixture of uranyl salts with oxalic acid absorbs the ultra-violet rays much more strongly than the sum of the constituents. Details of the quantitative study of the absorption are given.—Mme. **Demassieux**: Study of the equilibrium between lead chloride and potassium chloride in aqueous solution. The experimental results for three temperatures, 14°, 50°, and 100° C., are given in the form of a diagram.—Pierre **Jolibois**: Remarks on the note of R. Goubau on the melting point of arsenic. Reclamation of priority.—E. **Léger**: The constitution of homonataloin and of nataloin.—M. **Balland**: The return to wholemeal bread.—Jivoin **Georgévitch**: The evolutive cycle in the myxosporidia.—Edouard **Chatton**: The evolutive and cyclic transformations of the peridinian structures in certain parasitic Dinoflagellæ.—E. **Voisenet**: A ferment present in waters causing the dehydration of glycerol. An organism has been extracted from Dijon water identical in its morphological and biochemical characters with *Bacillus amaracrylus* from bitter wines. It can form acrolein from glycerol in aqueous solution.—Auguste **Lumière** and Jean **Chevrotier**: Antityphoid vaccination by the gastro-intestinal way. The preparation of the dried bacilli and the mode of introduction into the body are given in detail. Immunity is obtained without any objectionable secondary symptoms.—J. **Danysz**: Compounds of chlorine, bromine, and iodine of dioxydiamidoarsenobenzene and silver. To a solution of Ehrlich's compound 606 a solution of silver bromide in potassium cyanide is added; a compound of arsenobenzene with silver bromide is formed, which can be removed as an insoluble sulphate. The therapeutic and antiseptic properties of this and the analogous chlorine and iodine compounds have been studied.—Gabriel **Bertrand** and H. **Agulhon**: The rapid estimation of boric acid in food substances, normal or added. Utilising the colorimetric method of estimation described in an earlier communication, figures are given for the amounts of boric acid present in a large number of animal and vegetable foods.—H. **Hérissey** and A. **Aubry**: The biochemical synthesis of α-methylgalactoside. The α-galactodidase used in this work was obtained from low beer yeast dried in the air.—Em. **Bourquelot** and M. **Bridel**: The equilibria of ferments. Production of hydrolysis or synthesis according to the changes of composition of the mixtures.—J. **Deprat**: The layers with Fusulinideæ of Akasaka, Japan, compared with the similar horizons of China and Indo-China.—J. **Repelin**: The modifications brought about in the Provençal sheets by Alpine movements.

BOOKS RECEIVED.

Introduction to Modern Inorganic Chemistry. By Dr. J. W. Mellor. Pp. xvi+684. (London: Longmans and Co.) 4s. 6d.

The Banana: its Cultivation, Distribution, and Commercial Uses. By W. Fawcett. Pp. xi+287+plates. (London: Duckworth and Co.) 7s. 6d. net.

A School Course in Geometry. By W. J. Dobbs. Pp. xxii+427. (London: Longmans and Co.) 3s. 6d.

Slide-rule Notes. By Col. H. C. Dunlop and C. S. Jackson. Pp. 127. (London: Longmans and Co.) 2s 6d. net.

A Pocket-Book for Miners and Metallurgists. Compiled by F. D. Power. Third edition. Pp. xiv+371. (London: Crosby Lockwood and Son.) 6s. net.

Bücher der Naturwissenschaft. 18 and 19 Band. Der Wirbeltierkörper. By Dr. F. Hempelmann. Erster Teil. Pp. 185. 20 Band. Meereskunde. By Prof. A. Pahde. Pp. 190. (Leipzig: P. Reclam, jun.) 1.50 marks and 1 mark respectively.

Memoirs of the Queensland Museum. Vol. ii. Pp. 339+xxiii plates. (Brisbane: Government Printer.)

Pflanzenphysiologie. By R. Kolkwitz. Pp. 258+xii plates. (Jena: G. Fischer.) 9 marks.

Die realistische Weltansicht und die Lehre vom Raume. By Prof. E. Study. Pp. ix+145. (Braunschweig: F. Vieweg und Sohn.) 4.50 marks.

Models to Illustrate the Foundations of Mathematics. By C. Elliott. Pp. viii+116. (Edinburgh: Lindsay and Co.) 2s. 6d. net.

Astronomy: A Popular Handbook. By Prof. H. Jacoby. Pp. xiii+435+32 plates. (London: Macmillan and Co., Ltd.) 10s. 6d. net.

A List of the Birds of Australia. By G. M. Mathews. Pp. xxvii+453+map. (London: Witherby and Co.) 10s. net.

Exercises in Mathematics. By D. B. Mair. Pp. xi+469. (London: Macmillan and Co., Ltd.) 4s. 6d.

Analytic Geometry and Principles of Algebra. By Prof. A. Ziwet and L. A. Hopkins. Pp. viii+369. (London: Macmillan and Co., Ltd.) 7s. net.

Plane and Solid Geometry. By Prof. W. B. Ford and C. Ammerman. Edited by E. R. Hedrick. Pp. ix+321+xxxiii. (London: Macmillan and Co., Ltd.) 5s. 6d. net.

Handbuch der Entomologie. Edited by Prof. C. Schröder. 4 Lief. (Jena: G. Fischer.) 5 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. 71 Lief. (Jena: G. Fischer.) 2.50 marks.

The Petrology of the Igneous Rocks. By Dr. F. H.

Hatch. Seventh edition. Pp. xxix+454. (London: G. Allen and Co., Ltd.) 7s. 6d. net.

Biological-Statistical Report on the Produce of the Danish Sea-Fishery in 1910. By A. C. Johansen and E. Neergaard-Moller. Pp. 179. (Copenhagen: C. A. Reitzel.)

Gypsy Lore Society Monographs. No. 1. A Gypsy Bibliography. By Dr. G. F. Black. Pp. vii+226. (London: B. Quaritch.) 15s.

Iowa Geological Survey. Vol. xxii. Annotated Bibliography of Iowa Geology and Mining. By C. Keyes. Pp. 908. (Des Moines.)

Department of Commerce. Technologic Papers of the Bureau of Standards. No. 18. Electrolysis in Concrete. By E. B. Rosa, B. McCollum, and O. S. Peters. Pp. 137+plates. (Washington: Government Printing Office.)

A Course of Practical Work in the Chemistry of the Garden. By D. R. Edwardes-Ker. Pp. 40. (London: J. Murray.) 1s. 6d. net.

Tables for Facilitating the Use of Harmonic Analysis, as arranged by Prof. H. H. Turner. Pp. 46. (London: Oxford University Press.) 1s. net.

Tierische Immunität. By Dr. W. Rosenthal. Pp. x+329. (Braunschweig: F. Vieweg und Sohn.) 6.50 marks.

From the Letter-Files of S. W. Johnson. Edited by his Daughter, E. A. Osborne. Pp. v+292. (New Haven: Yale University Press; London: Oxford University Press.) 10s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 29.

ROYAL SOCIETY, at 4.30.—The Origin of Thermal Ionisation from Carbon: Prof. O. W. Richardson.—The X-ray Spectra given by Crystals of Sulphur and Quartz: Prof. W. H. Bragg.—The Temperature Variation of the Photo-elastic Effect in Strained Glass: Prof. L. N. G. Filon.—Studies in Brownian Movement. I. The Brownian Movement of the Spores of Bacteria: J. H. Shaxby and Dr. Emrys Roberts.—The Transmission of Kathode Rays through Matter: Dr. R. Whiddington.—The Variation with Temperature of the Specific Heat of Sodium in the Solid and the Liquid State; also a Determination of its Latent Heat of Fusion: Ezer Griffiths.—Radiation from a Gas: Dr G. Green.—Similarity of Motion in Relation to the Surface Friction of Fluids: Dr. T. E Stanton and J. R. Pannell.—The Influence of Molecular Constitution and Temperature on Magnetic Susceptibility: A. E. Oxley.—The Boiling Point of Sulphur on the Thermo-dynamic Scale: N. Eumorfopoulos.

ROYAL INSTITUTION, at 3.—The Mind of Savage Man: His Moral and Religious Life: W. McDougall.

CONCRETE INSTITUTE, at 7.30.—Discussion on "A Standard Method of Measurement for Reinforced Concrete."

SOCIETY OF DYERS AND COLOURISTS, at 8.—(1) The Effects of Mineral Loading upon the Physical Qualities of Hedychium Paper; (2) Tests to Determine the Relative Strength and Elasticity of Some Natural Fibres: Clayton Beadle and Dr. Henry P. Stevens.

FRIDAY, JANUARY 30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Testing of Materials for Use in Engineering Construction: E. W. Monkhouse.

SATURDAY, JANUARY 31.

ESSEX FIELD CLUB (at the Essex Museum of Natural History, Stratford), at 6.—Notes on a Trip to Swedish Lapland, with Remarks on the Lichens Collected: D. I. Scourfield and R. Paulson.—British Oysters, Pliocene to Recent: A. Bell.—Scientific Surveys: Rev. C. H. Grinling.

MONDAY, FEBRUARY 2.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Oxygen and Metallic Antimony in Crude Antimony: W. R. Schoeller.—Estimation of Zinc in Coinage Bronzes by Volatilisation: T. K. Rose.—Nickel Tannates: Puran Singh.

ARISTOTELIAN SOCIETY, at 8.—Intuitionism Translated from the Russian of Prof. Losskij: Mrs. Duddington.

SOCIETY OF ENGINEERS, at 7.30.—Presidential Address: H. C. H. Shenton.

ROYAL SOCIETY OF ARTS, at 8.—The Relation of Industry to Art: Sir Charles Waldstein.

TUESDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 3.—Animals and Plants under Domestication: Prof. W. Bateson.

ZOOLOGICAL SOCIETY, at 8.30.—An Annotated List of the Reptiles and Batrachians collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: G. A. Boulenger.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. XII. Further Observations upon the Genus Urocystidium Beddard: Dr. F. E. Beddard.—Report on the Deaths which occurred in the Zoological Gardens during 1913: H. G. Plimmer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Problem of the Thrust Bearing: H. T. Newbigin.

ROYAL SOCIETY OF ARTS, at 4.30.—The Montreal, Ottawa, and Georgian Bay Canal: Sir R. W. Perks, Bart.

RÖNTGEN SOCIETY, at 8.15.

WEDNESDAY, FEBRUARY 4

AËRONAUTICAL SOCIETY, at 8.30.—Further Developments of Military Aviation: Lieut.-Col. F. H. Sykes.

GEOLOGICAL SOCIETY, at 8.—The Lithology and Composition of Durham Magnesian Limestones: C. T. Trechmann.—The Occurrence of a Giant Dragon-fly in the Radstock Coal-measures: H. Bolton.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Iodimetry of Arsenic, Copper and Iron: Dr. G. D. Lander and J. J. Geake.—The Composition and Analysis of Compound Liquorice Powder: A. E. Parkes and F. Major.—The Composition of the Saline Matter adhering to certain Wet Salted Skins: M. C. Lamb.

ENTOMOLOGICAL SOCIETY, at 8.—The Myrmecophilous Aphides of Great Britain: Prof. F. V. Theobald.

ROYAL SOCIETY OF ARTS, at 8.—Motor Fuels, with Special Reference to Alcohol: Dr. W. R. Ormandy.

THURSDAY, FEBRUARY 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Conduction of the Pulse Wave and the Measurement of Arterial Pressure: Prof. F. Hill, J. McQueen and M. Flack.—Report of the Monte Rosa Expedition of 1911: J. Barcroft, M. Camis, C. G. Mathison, F. Roberts and J. H. Ryffel.—Some Notes on Soil Protozöa. I: C. H. Martin and K. Lewin.—The Development of the Starfish *Asterias rubens* L: J. F. Gemmill.—The Floral Mechanism of *Welwitschia mirabilis* (Hook): Dr. A. H. Church.

ROYAL INSTITUTION, at 3.—Types and Causes of Earth Crust Folds: Sir Thomas H. Holland, K.C.I.E.

LINNEAN SOCIETY, at 8.—The Vegetation of White Island, New Zealand: W. R. B. Oliver.—Lantern-slides of Cape Plants, mostly in their Native Habitats: W. C. Worsdell.—The Range of Variation of the Oral Appendages in some Terrestrial Isopoda: W. E. Collinge.

FRIDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 9.—The Mechanics of Muscular Effort: Dr. H. S. Hele Shaw.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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For Advertisement Rates, Terms of Subscriptions, &c., see page ccxxxv of the present issue of "Nature."

THURSDAY, FEBRUARY 5, 1914.

THE SCIENCE AND PHILOSOPHY OF INSTINCT.

Instinct and Experience. By Prof. C. Lloyd Morgan, F.R.S. (London: Methuen and Co., Ltd., 1912.) Pp. xvii + 299. 5*s*. net.

THIS is an important contribution to the much-discussed subject of instinct. It reveals a perplexing discrepancy of opinion among those who have recently given special attention to the nature of instinctive behaviour in its biological and psychological aspects, and the way in which the author deals with the views of Bergson, Driesch, McDougall, Myers, Stout, and many others is a model of what scientific discussion should be. Perhaps it does not make the book easier to read, but there is a fascination in his Darwin-like method of anticipating difficulties, answering criticisms that have been made, and forestalling others that will be forthcoming all the same. It is now many years since Prof. Lloyd Morgan began a new chapter in the study of instinct, marked by clear-cut experimental work on one hand, and philosophical insight on the other; and in this new book he has made us again his debtors. He is always lucid and always fair; and his vivid, arresting style is especially welcome when the subject-matter is necessarily difficult.

Let us quote a fine summary of much research and thought:—

"Instinctive behaviour is that which is, on its first occurrence, independent of prior experience; which tends to the well-being of the individual and the preservation of the race; which is similarly performed by all the members of the same more or less restricted group of animals; and which may be subject to subsequent modification under the guidance of experience. Such behaviour is, I conceive, a more or less complex organic or biological response to a more or less complex group of stimuli of external and internal origin, and it is, as such, wholly dependent on how the organism, and especially the nervous system and brain-centres, have been built through heredity, under that mode of racial preparation which we call biological evolution."

"Instinct," Lloyd Morgan goes on to say, "is organic behaviour suffused with awareness." Biologically considered, an instinctive act is nothing but a reflex; psychologically considered, it is always something more, in so far as it affords data to the conscious experience which has its physical basis in the higher reaches of the nervous system. The book's particular thesis, which applies primarily to vertebrate animals, is that instinctive behaviour, biologically considered, is dependent upon inherited dispositions within the lower brain-centres. In virtue of these inherited dispositions, the organism appropriately stimulated exhibits adaptive responses, and is subject to visceral disturbances. These afford new stimuli which in turn affect the lower brain-centres. But not these alone, for the initial sensory stimuli, those from the motor organs concerned in behaviour, and those from the viscera, likewise stimulate the cortex of the cerebral hemispheres, with the functional activity of which experience is correlated. And this plays down upon the activities of the lower nerve-centres, controlling them intelligently.

"There are, of course, inherited dispositions in the cortical centres also, which determine mental tendencies. These may be called innate, reserving the narrower term instinctive for behaviour of a specific congenital type, dependent on purely biological conditions, nowise guided by conscious experience, though affording data for the life of consciousness."

Instinctive behaviour is determined by the subtly compounded reflex actions of the lower centres; it is due to the integrative action of these centres; it differs from compound reflex actions (in the ordinary acceptation) in being the outcome of a more complicated coordination. A decerebrate animal may exhibit instinctive behaviour, but, it is pointed out, this fact does not contradict the view that in the intact animal orderly impulses due to performance of instinctive acts may reach the cortex and there generate experience. This experience may form the basis of subsequent cortical or intelligent modification of the instinct, as is continually happening.

Besides its direct contributions to the theory of instinct, the book contains much that is of great value for the student of science and philosophy. Thus it emphasises from first to last the important rule of method "that the more clearly we distinguish the scientific problem from the metaphysical problems the better it will be both for science and for metaphysics"; and another dominant idea is that "the history of the universe, so far as we are able to read it, is one continuous story, every episode in which is, if we may so phrase it, logically correlated with other episodes." So that even the richness and complexity of conscious awareness in human life is the highest outcome of the logic of the world-story, developed *ab intra,* and not an alien insertion from without. Both these general ideas command our heartiest allegiance.

A A

TECHNICAL CHEMISTRY.

(1) *The Fermentation of Cacao.* Edited by H. H. Smith. With a foreword by Sir George Watt, C.I.E. Pp. lv + 318. (London: John Bale, Sons, and Danielsson, Ltd., n.d.) Price 10*s.* net.

(2) *Chemistry and its Relations to Daily Life.* By Prof. L. Kahlenberg and Prof. E. B. Hart. Pp. vii + 393. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 5*s.* 6*d.* net.

(3) *Industrial Poisoning from Fumes, Gases, and Poisons of Manufacturing Processes.* By Dr. J. Rambousek. Translated and edited by Dr. T. M. Legge. Pp. xiv + 360. (London: Edward Arnold, 1913.) Price 12*s.* 6*d.* net.

(4) *The Application of Physico-Chemical Theory to Technical Processes and Manufacturing Methods.* By Prof. R. Kremann. Translated from the German by H. E. Potts, and edited by Dr. A. Mond. Pp. xv + 212. (London: Constable and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

(1) THIS is a collection of essays published during the last few years in Germany, Holland, the United States, and this country, discussing the methods and effects of fermentation as applied to the preparation of cacao ("cocoa"). Raw cacao beans, on being removed from the pods and placed in covered heaps, undergo alcoholic and acetic fermentation of the adherent pulp. This loosens the testa of the beans, and improves the quality of the kernel by reducing the amount of bitter astringent substances, developing the aroma, and producing the desired chocolate colour. As to how precisely the improvement is effected there is difference of opinion. Oxidation, either direct or by means of an oxidase; the action of acetic acid, or of heat, or of glucoside-splitting enzymes, are some of the explanations put forward.

Two important suggestions for improving the industry are made: one is that instead of trusting to chance to bring the right kinds of yeast, the planter should employ suitable cultures for starting and prolonging the fermentation. A definite culture of yeast would ensure a more uniform product. The second suggestion is that the "juice" from the fermentation, large quantities of which are now run to waste, might be manufactured into vinegar, which should become a considerable asset to the planter.

(2) Theory has been kept down to the minimum in this work, which is intended for students of agriculture and home economics in (American) secondary schools. The authors take common substances for their material—water, air, vinegar, soda, coal, soap, sugar, clay, wool, bread, milk, and so on. By discussing and experimenting upon these the student is led to a knowledge of some of the fundamental facts of chemistry. The descriptions are simple and interesting; the instruction is sound so far as it goes; and the more important points are emphasised by using different kinds of type in the letterpress. A good deal of life is infused into what many students would regard as the dry bones of chemistry, and many illustrations are provided which further serve to brighten the pages. Students who are not making chemistry their primary study, but desire to have some knowledge of the chemical properties of common articles, will find the book full of trustworthy information.

(3) Dr. Rambousek, a medical man and a chemist, is also professor of factory hygiene and chief State health officer at Prague. He may therefore be regarded as specially qualified to compile a work dealing with the occurrence of poisoning in industrial occupations. The number of such occupations attended with risk is perhaps in general scarcely realised. Thus besides lead and phosphorus poisoning, cases occur in connection with the larger chemical industries (sulphuric acid, bleaching powder, hydrochloric and nitric acids), and with the use of phosgene gas, chloro- and nitro-benzene, methyl bromide, carbon disulphide, aniline, petroleum products; brass, chromates, ferro-silicon, mercury, and nickel carbonyl. The author gives an outline of the dangerous processes, then describes symptoms and treatment, and finally gives an account of the preventive measures hitherto adopted or suggested. The field is so wide that exhaustive discussion within the limits of one small volume is impracticable; but the large number of references supplied will help to remedy this defect.

(4) This work, the English editor explains, is one of a series of monographs on technical chemical methods of manufacture, written by experts and published first in Germany, where they have had an encouraging reception.

The book contains the substance of lectures delivered by Prof. Kremann, whose experience has taught him that the beginner shows most interest in those problems of physical chemistry which have a bearing upon technical questions.

Starting with the fundamental laws of the mechanical theory of heat, the law of mass action is deduced, and the maximum work of a chemical process discussed, the results being then applied to a consideration of the theory of gas engines and of gaseous and solid explosives. The phenomena of catalysis and pseudo-catalysis are next dealt with, examples of practical application being furnished by the manufacture of sulphuric acid, the Deacon process for chlorine, and the drying of linseed oil. Special cases depending on the law of mass action are found in the production of nitric acid and of ether, and in the caustification of sodium carbonate. The rest of the book is chiefly concerned with applications of the phase rule to manufactures, for example, lime-burning, lead roasting, blast-furnace reactions, and the Solvay ammonia-soda process. Technical chemists and students would often find the book useful and suggestive.

OUR BOOKSHELF.

Meteorological Office. The Observer's Handbook, 1913. Pp. xxiv + 157 + plates. (London: H.M. Stationery Office, 1913.) Price 3s.

The issue of an annual edition of this work, arranged in 1909, was very appropriate—from a scientific point of view—owing to the rapid advance of meteorological research in recent years. The progress of aërial navigation and the proposed general extension of the centimetre-gram-second system of units to meteorological measurements give greater force to the desirability of the arrangement. The work is divided into four principal sections, most carefully prepared with due regard to requirements of observers and to decisions of international conferences. Part i. relates mostly to normal climatological stations and to non-instrumental observations. The articles referring to modifications of aqueous vapour and to optical phenomena are especially interesting. Parts ii. and iii. deal with self-recording and additional instruments, special attention being given to the attainment of accuracy in their working. Part iv. contains reduction and conversion tables, including those adapted for the c.g.s. system. An introductory memorandum on the proposed new units, to be used for bringing meteorology into line with allied sciences, is most useful. Certainly the learning of them "does involve a definite effort to begin with," but the proposed regraduation of instruments will, as pointed out elsewhere, probably remove the main objection to the innovation.

Handbuch der Hygiene. Herausgegeben von Prof. M. Rubner, Prof. M. v. Gruber, and Prof. M. Ficker. III. Band 3. Abteilung. Die Infektionskrankheiten. Pathogene tierische Parasiten. (Protozoen, Würmer, Gliederfüssler.) Pp. 392 + plates. (Leipzig: S. Hirzel, 1913.) Price 24 marks.

Following upon an introduction of fourteen pages dealing with the general problems of parasitology, the book is divided into three sections dealing with parasitic protozoa (224 pp.), worms (101 pp.), and arthropods (28 pp.), the last section being written by W. von Schuckmann, and the rest of the book by Th. von Wasielewski. Each section is accompanied by reference to the main literature on the subject of which it treats. The book is excellently illustrated by means of thirty-two coloured plates and 192 text-figures, many of which are original.

The section on protozoa deals in the main with the forms which are parasitic in man, the subjects of trypanosomiasis, leishmaniasis, amœbiasis, malaria, and balantidium-dysentery being treated of at length. A short section deals with organisms doubtfully related to protozoa—Spirochæta, Haplosporidia, and Chlamydozoa. The section on worms also deals mainly with the species which are parasitic in man. Compared with these sections the one on arthropoda appears distinctly inadequate, the illustrations being mostly bad and antiquated. The legends to figures of Hæmatopota and Stomoxys (p. 76) are unfortunately reversed. Due credit is given throughout to the sources whence illustrations are borrowed. An annoying custom in bibliographies to German publications may be noted in that "Ders." and "Dies." printed in the same type as authors' names, are used instead of dashes beneath the name or names heading the first title—this is most distracting to the eye.

Prof. von Wasielewski may well be congratulated upon his excellent treatise, which will prove most useful to hygienists, for whom the "Handbuch der Hygiene" is primarily intended.

G. H. F. Nuttall.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Pressure of Radiation.

I quite agree with Mr. C. G. Darwin's opinion, expressed in Nature of January 22, that Boltzmann's proof of the fourth-power law, taken as he gave it, or as it is usually given in the text-books, cannot be applied as it stands to each separate frequency, because the adiabatic expansion, employed in performing the cycle, will bring the Doppler effect into play, and cause a small change in the frequency, thus confusing the issue. But I think the reason of this is that the proofs usually given assume too much, and neglect an essential point, expressly emphasised by Carnot himself in the application of his principle to the case of a saturated vapour. According to my view, the application of Carnot's principle to a single frequency should run somewhat as follows.

Since the emission of radiation of constant frequency, independent of the temperature, is a characteristic property of matter, we are justified, for the purpose of argument, in assuming an ideal cylinder and piston of a material capable of emitting only a single frequency, or a narrowly restricted range. Generate a *finite* volume v of radiation in such a cylinder at a constant temperature T and pressure p. The work done on the piston is pv, and the total heat absorbed $E+pv$, where E is the intrinsic energy of the radiation generated. Cool the cylinder at constant volume through an *infinitesimal* range, dT, by abstracting heat CdT, where C is the thermal capacity of the cylinder and its contents. An infinitesimal proportion of the radiation will be condensed, and the pressure will fall to the equilibrium value, $p-dp$, corresponding to the temperature $T-dT$. There is no change of frequency since the volume is not altered. Complete the cycle by condensing the volume v at $T-dT$, and heating the cylinder to its original temperature. The cycle is reversible, and the infinitesimal CdT may be made as small as we please in comparison with $E+pv$. The external work done in the cycle is $v(dp/dT)dT$, and is equal to the fraction dT/T of the heat absorbed, $E+pv$. Whence $E/v=T(dp/dT)-p$.

I cannot see any escape from this conclusion so long as Carnot's principle is accepted for the definition of the absolute scale of temperature. Still less is there any escape from the conclusion, depending only on the first law, that the quantity measured experimentally is $E/v+p$, and not E/v, as generally assumed. Both conclusions are inconsistent with much of Wien's reasoning, but I have shown that they are not inconsistent with his displacement law. My formula satisfies all three conditions, makes the entropy of the distribution a maximum, and the thermodynamic potential the same for each frequency.

H. L. CALLENDAR.

Imperial College of Science, S.W.

Atomic Models and X-Ray Spectra.

I AM unable to agree with Sir Oliver Lodge (NATURE, January 29, p. 609) that the impossibility of the existence of two coplanar rings of electrons with the same angular velocity is self-evident, though it is proved very simply. For the mutual repulsions of the electrons in different rings are complicated, and their effect on any ring varies very much with the number of electrons. I think the amount of proof given in my letter is necessary, especially since, in discussions of two rings, inequality of angular velocity has not often been mentioned.

Although my illustrative case concerns rings with the same angular velocity, the greater part of the letter relates to rings with different angular velocities, as, of course, in Bohr's theory, the angular momenta of the electrons are equal, thus precluding identity of angular velocity in any two coplanar rings. It must be borne in mind that the portion of Bohr's theory which deals with coplanar rings is admittedly more tentative than that relating to spectra. The point of my letter was that this part of the theory needs modification; and, of course, it is not essential to the other. The variations from circular orbits may be shown to be cumulative, when the orbits are coplanar, and, in fact, it is possible to prove the non-existence of approximately circular orbits from considerations of angular momentum alone, and as this investigation will be published in detail shortly, there is no necessity to enter further upon it now. But, in particular, the nearest possible approximation to a circular orbit for the two inner electrons of Bohr's lithium atom makes their distances from the nucleus in the ratio 12 to 1 for certain positions.

In fact, the only possible arrangement of three electrons with equal angular momenta, in which the orbits are circular, requires all to be in the same circle, and such an atom can be shown by Bohr's method to be as inert as helium. Lithium therefore cannot have a nucleus of strength $3e$, and we cannot retain both Bohr's theory and van den Broek's hypothesis. One at least must be abandoned, and the latter must certainly, for lithium, beryllium, and boron, all of which can be treated very simply on theoretical grounds.

An important argument can be derived from astrophysics. These three elements are, so far as can be judged, practically unknown in celestial spectra, where hydrogen and helium are strong. This seems to imply no great similarity in constitution.

J. W. NICHOLSON.

University of London, King's College.

IN the recent discussion in NATURE on the constitution of the atom, attention has been directed mainly to the electrostatic forces exerted by the positively charged portion of the atom. Prof. Nicholson has been successful in calculating the frequencies of the lines in the nebular and coronal spectra on this basis by employing Rutherford's model atom consisting of a central nucleus surrounded by a ring (or rings) of electrons. Bohr's theory, though not dependent on the usual dynamical laws, involves the calculation by ordinary mechanics of the steady motion of the electron in the electrostatic field of the positive nucleus. In the case of a *simple* nucleus this procedure leads to results as to the frequencies that agree with observation. It may, however, be necessary to suppose, at least in the case of the heavier atoms, that the nucleus produces not only an electrostatic but also a magnetic field. Such a view has recently been developed by Prof. Conway using the atomic model of Sir J. J. Thomson. If we adopt Rutherford's model the expulsion of α and β particles from radio-active substances with large velocities may indicate that the particles possess these velocities *within the nucleus*. If they are in orbital motion a magnetic field would exist outside the nucleus.[1] This hypothesis may be associated with the theory of the Zeeman effect put forward by Ritz, and also with the theories of magnetic action developed by Langevin and by Weiss. According to the latter, there exists an elementary magnet, the *magneton*, which is common to the atom of a large number of different substances.

Prof. Nicholson regards Planck's universal constant h as an angular momentum. According to Bohr's theory the angular momentum of an electron is constant and is $h/2\pi$. Prof. Conway, using a different model, obtains the value h/π. Prof. McLaren identifies the natural unit of angular momentum with the angular momentum of the magneton. It has been pointed out (*Phys. Zeitsch.*, vol. xii., p. 952, 1911) that Planck's constant may be connected with the magnetic moment of the magneton. Suppose that an electron (charge e, mass m) is moving in a circular orbit (radius a) with angular velocity ω. Then its angular momentum is $ma^2\omega$, and the magnetic moment of the equivalent simple magnet is $\frac{1}{2}ea^2\omega$. Thus the magnetic moment is equal to some constant multiplied by he/m. Taking (for illustration only) Bohr's value for the angular momentum, we obtain as the magnetic moment 92×10^{-22} E.M.U. The magnetic moment of the magneton, as given by Weiss, is a quantity of about the same order of magnitude, viz. $15{\cdot}94 \times 10^{-22}$.

My chief object is to direct attention to the work of Prof. Carl Størmer, of Christiania, on the path of an electron in the magnetic field of an elementary magnet. It would be of great interest if it should prove that his results, originally obtained in connection with cosmical problems, are applicable within the atom. In addition to computing the trajectories corresponding to different circumstances of projection in the field of an elementary magnet, he has investigated the corresponding problem when the electron is also under the action of a central force varying inversely as the square of the distance from the centre of the magnet (*Videnskabs-Selskabets Skrifter*, 1907, Chris-

[1] This view necessitates a larger estimate for the diameter of a complex nucleus than that at present accepted.

tiania; *Comptes rendus*, vol. clvi., pp. 450, 536, 1913). In particular he finds certain remarkable periodic trajectories in the form of circles the plane of which is perpendicular to the axis of the magnet and the centre of which is at some point on that axis. If this point coincide with the centre of the magnet we obtain circular orbits in the equatorial plane of the magnet. Further, there are other trajectories which never get outside closed toroidal spaces in the case of stability, or which approach asymptotically the circle in question in the case of instability. It appears probable that similar results would be obtained in the case of a ring of electrons, and that the outstanding problem of the stability of such a rotating ring when only electrostatic forces are considered might in this way be overcome. Experimentally such stable rings have been obtained by Birkeland by employing a magnetised sphere inside a vacuum tube.

Some of the orbits calculated by Störmer are also suggestive in connection with the wide angle scattering of α particles investigated by Rutherford and by Geiger and Marsden. If the nucleus produce a magnetic field, Rutherford's estimate of its radius may require modification.

H. S. ALLEN.

Wheatstone Laboratory, King's College, London.

I HAVE read the letters of Dr. Bohr and Mr. Moseley with great interest, and would like to make a few remarks in reply which may serve to render the meaning of my first letter more clear. Dr. Bohr says that we have no right to consider nNe^2, m, r, and h as independent variables and that we must eliminate r, in which case we find his formula. I am not convinced that this is necessary *a priori*, as Dr. Bohr would seem to consider it. In some cases it leads to conclusions which are obviously erroneous. Supposing, for instance, that we calculate the period of a pendulum by this method. If we eliminate h we find $t = \text{const.}\sqrt{\frac{l}{g}}$, but if we eliminate l we find $t = \text{const.}\sqrt[3]{\frac{h}{mg^2}}$. We have just as much or just as little reason, *a priori*, to eliminate h or r, or any of the quantities involved in one case as in the other. In the case of the pendulum, h can only appear as a corrective term, perhaps of a form similar to $\sqrt{1 - \frac{h\nu}{E}}$, where E is the energy. Possibly the same is true in atomic models.

I suggest that Mr. Moseley's frequencies, which can be represented by various equations, do not prove that one must necessarily adopt the formula obtained by eliminating r. But even if it be admitted that r must be eliminated *a priori*, the fact that we then always find a formula which, as Dr. Bohr admits, only differs from his in the constant, seems to me to justify my view that the fact that the frequencies agree with the formula does not necessarily confirm Dr. Bohr's special assumptions. The support to be derived from an agreement in the matter of the constant, however, is not very strong, as, according to Dr. Bohr's theory, it contains a factor of the form $(1/\tau_1^2 - 1/\tau_2^2)$ which obviously gives us the choice of an infinite number of values between O and $2\pi^2(N - \sigma_n)^2$.

Mr. Moseley also adduces arguments only in favour of what he calls the h hypothesis, not of Dr. Bohr's special assumptions. The reasons, however, do not appear to me absolutely convincing. Thus he says $\nu \sim (Fr^2)^2$, where F is the resultant electrostatic force on one electron, and concludes that as $M^{\frac{1}{2}}.L^2T^{-1}$ is constant, ML^2T^{-1} is constant. He thus introduces various hypotheses, such as that the same number of electrons oscillate in every atom, that there exist no other forces than electrostatic, and so on. If one liked, the fact that $\nu \sim N^2$ might just as well be interpreted as $\nu \sim Fr^2$, assuming N electrons to be attracted, whence we could deduce $ML^2.L/T = \text{const.}$, *i.e.* a universal velocity times a universal moment of inertia. Mr. Moseley says no independent natural unit of length is known. It is very easy to imagine atomic models in which one occurs, as, for instance, that proposed by Sir J. J. Thomson at the last meeting of the British Association.

There are one or two other points which do not seem to confirm Mr. Moseley's interpretation of the phenomena which he has observed. Mr. Moseley himself found, I believe, several lines in the characteristic platinum radiation, which are not where they should be according to his hypothesis, *i.e.* about in the region of wave-lengths two octaves shorter than copper. M. de Broglie has shown by means of the ingenious method for photographing X-ray spectra described by him in the *Comptes rendus de l'Académie des Sciences*, November 17, 1913, and completed December 22, 1913, and January 19, 1914, that platinum antikathodes emit at least ten independent lines. Although the whole spectrum was photographed, including the shortest wave-lengths, and although a continuous spectrum was observed in the region in which the lines were to be expected, the lines themselves were not present. Unless we ascribe all the strong lines observed to impurities and introduce a special hypothesis to account for the fact that the expected platinum lines are not observable, this seems to constitute a grave difficulty for the theory of Mr. Moseley. I have misgivings further as to the ring of four electrons being able to emit such strong lines as those observed, as the radius of the ring is about one hundred times smaller than the wave-length, but no doubt Mr. Moseley has considered this obvious objection, and satisfied himself that it is unfounded.

To recapitulate. It seems to me that Dr. Bohr postulates the h hypothesis, and that Mr. Moseley derives it by introducing a hypothetical model. That the h hypothesis does not entail Dr. Bohr's model. That Dr. Bohr's constant as applied by Mr. Moseley contains a factor which varies from 0 to 1, and that $\frac{3}{4}$ the value chosen is entirely arbitrary. Therefore my view is that all that can be said of Mr. Moseley's observations is, that they do not contradict Dr. Bohr's assumptions, not that they confirm them.

F. A. LINDEMANN.

Paris, January 25.

Systems of Rays on the Moon's Surface.

IT is a strange fact that those who have little experience of volcanoes notice a rough resemblance between the irregularities of the lunar surface and terrestrial volcanic vents. However much one juggles with diminished gravity and magnifies volcanic energy in the past history of our satellite, there are still several facts which are overlooked by many theorists. Mr. C. H. Plant points out in NATURE of January 15 (p. 550) that the "volcanic action of the moon was of enormous character"—this would need be so to produce on such a small globe craters of 80 kilometres or more in diameter.

Now all large craters are the result of explosive action, and, in explosive action, only fragmentary ejecta are thrown out by the amount of volatile constituents of the magma, which, if sufficient to excavate a crater, are also sufficient to break up all the igneous magma into scoriaceous or pumiceous materials, and not allow it to issue continuously as a lava stream. When lava rises, subsequent to an explosive eruption such as excavated these gigantic craters, its first effect will be to fill up the crater before overflowing the edges.

Lateral outpourings can only occur when the cone has been sufficiently rebuilt, above the level of the surrounding country, to give enough hydrostatic force to rend this cone.

The radiating rays around these craters cannot be lava streams, as these only flow out of the crater by its lowest lip. They are not due to landslips of the loose ejecta collected on the slopes of the cone, such as I described and figured in my book on the great Vesuvian eruption of 1906, and which had until then been attributed to water erosion, for the following reason. These ravines, like the depressions around a half-opened umbrella, are straight radially and not sinuously radial as in those surrounding the great craters of the moon.

Were these radial rays lava streams, which originally issued from a cone now truncated by a later explosive eruption, then they would have been obliterated by the enormous mantle of fragmentary materials that would have been ejected.

These rays have more the appearance of erosion valleys, but this we cannot admit if physicists maintain that there is no lunar atmosphere to speak of.

Their greatest resemblance, however, is with the irregular, radial cracks formed around the splash of a missile striking a comparatively hard surface, such as is observable when bullets are fired into soap, hard clay, lead, or half-set plaster, or even steel.

The more I compare the moon's surface with volcanic vents in different parts of this world the less I see a resemblance between the two, and the more does the planetoid and meteorite projectile theory become acceptable. The obviously asymmetrical craters with high, overhanging, narrow lip on one side, and low, broad lip on the opposite side, point to the impact of the meteorite being oblique to the moon's surface. The long, deep furrows, such as the valley of the Alps, &c., are, to my mind, formed by bolides ploughing in a path of high ellipticity the surface of the moon, but at so low an angle as not to penetrate its surface.

I think it a great pity that a good lunar-observing astronomer with one of the most powerful telescopes at his disposal, does not collaborate with a thoroughly practical vulcanologist to examine many of the lunar features without very rigidly fixed preconceived ideas. How often have I wished to be able to study carefully the moon's surface, and no doubt astronomers have often craved for a more extensive vulcanological knowledge. H. J. JOHNSTON-LAVIS.

Villa Lavis, Beaulieu-sur-Mer, January 26.

The End-product of Thorium.—A Suggestion.

THE chemical composition of thorites and thorianites does not seem to suggest any probable end-product for the contained thorium. It has occurred to us that the only explanation at present available is that the end-product is an isotope of thorium itself. This condition might be brought about by the emission of sufficient β rays.

If this be the case, thorium, as we know it, must be a mixture of two isotopic elements, one of which is radio-active. There is some support in favour of this suggestion to be found in the erratic position of thorium on the Geiger-Nuttall curve (*Phil. Mag.*, October, 1912). According to this curve, the value of λ for thorium, as observed, is too low. Now, if there is a stable component present, this result will naturally arise.

From the position of thorium on the diagram it is possible to estimate the value of λ for the active constituent on the above hypothesis. It comes out approximately as $1\cdot0\times10^{-16}\,\text{sec}^{-1}$. The percentage of this active constituent would appear to be about 0·7. It is also possible to estimate the time for this composition to have been attained, starting from the pure active constituent. The time appears to be about $1\cdot6\times10^{9}$ years.

The view that thorium possesses a radio-active constituent as determined above may, of course, be made the basis of an independent hypothesis.

J. JOLY.
J. R. COTTER.

Trinity College, Dublin, February 3.

A Curious Ice Formation.

I AM taking the liberty of enclosing a photograph of an occurrence which, so far as I am aware, is quite unique for this part of the country, and will no doubt have some interest for your readers.

The water was frozen during the night of December 31, 1913 (on which night at least 14° of frost were registered) into circular floes of ice of varying diameter, which, being encrusted with snow, had the appearance of water-lilies.

Photo.] [*J. Clark, Brecon.*

The river at this point flows almost due southward, and has just passed under a bridge over a weir, at both ends of which is a whirlpool.

The accompanying photograph shows the east whirlpool as it appeared on New Year's Day.

The river, I may mention, is the Usk, and the photograph was taken at Brecon.

D. J. PHILLIPS.

University College of South Wales and Monmouthshire, Cardiff.

Soil Protozoa.

IN a letter to NATURE (No. 2266, vol. xci., 1913) one of us (C. H. M.) gave an account of a method of obtaining permanent preparations of Protozoa in the state in which they were living in the soil.

The fixative used in this method was picric acid in saturated aqueous solution, but we have since found this reagent to be less serviceable in the case of clay soils than the following mixture:—Saturated aqueous solution of mercuric chloride, 1 pt.; methylated spirit, 1 pt. The soil should be crumbled into this fluid, and mixing is best accomplished by gently shaking the containing vessel, care being taken to avoid making the clay component of the soil pass into suspension.

A delicate film containing Protozoa will appear on the surface of the liquid, and this can be removed by floating cover-slips over it, and stained by the usual methods. K. R. LEWIN.
C. H. MARTIN.

Lawes Experimental Laboratory, Rothamsted, January 27.

The Eugenics Education Society.

IN NATURE of January 29 there is a letter from Prof. Karl Pearson pointing out that he has been misquoted in *The Eugenics Review*, the word "years" having been substituted for the words "few months." An apology to Prof. Pearson for this purely accidental blunder will appear in the next issue of the review. I should be glad if you would give me space to say through your columns also that we much regret that this mistake was made.

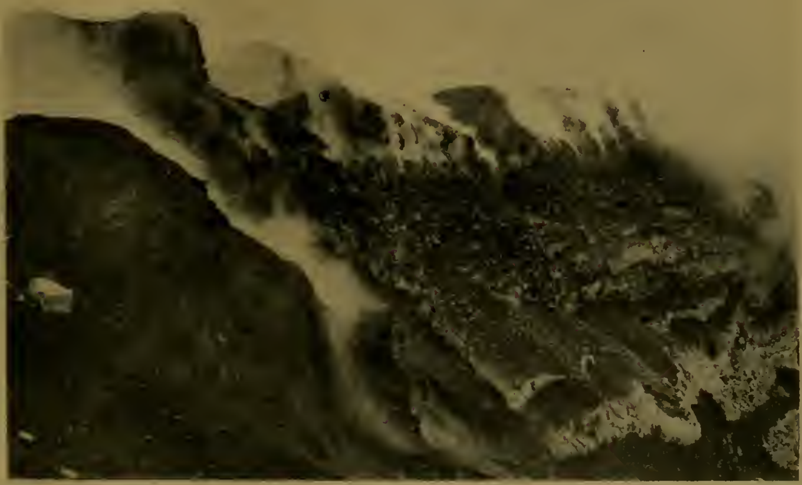
LEONARD DARWIN.
(President.)

The Eugenics Education Society, Kingsway House, Kingsway, W.C., January 31.

OBSERVATIONS AT THE BOTTOM OF THE CRATER OF VESUVIUS.

SINCE the appearance of the interesting memoirs of M. A. Brun, of Geneva, and the publication of his important monograph, no problem has appealed to vulcanologists with greater force than that concerned with the nature and origin of the gases which produce explosive action in volcanoes. That water-gas appears in enormous quantities during explosive eruptions cannot be doubted, for it is condensed in heavy rain-torrents; but it is by no means certain that these abundant watery vapours may not be due, wholly or in large part, to moisture derived originally from the atmosphere. M. Brun regards the long prevalent opinion among geologists—that the hydrochloric acid, sulphurous acid, nitrogen, and other gases, which are undoubtedly present, are quite subordinate to the water-gas—is an erroneous one; he, on the other hand, maintains that his observations prove (alike in the blasts of vapour from volcanic vents, in the distension of molten lava into pumice, and its dispersion as dust) that water plays but an insignificant part as compared with other gases.

The discovery by Prof. Malladra of a practicable route by which the very lowest point in the present Vesuvian crater can be reached, and its utilisation by Mr. Frederick Burlingham for kinematographic work, promise to furnish a means by which the rival views concerning the nature of the volcanic gases may be put to a crucial test. The floor of the present crater of Vesuvius lies at a depth of about 1000 ft. below the crater-rim; in this floor a funnel-shaped opening 200 ft. deep was opened last July, after the volcano had sunk to the solfataric condition following the great and destructive eruption of 1906; at the bottom of this funnel (1212 ft. from the summit of the volcano) considerable, and apparently increasing, activity is taking place. It remains to be seen whether this activity will eventuate in the formation of a cone rising from the present crater-floor, or in a violent paroxysm that will carry away the crater-floor and increase the depth of the cavity.



Copyright] FIG. 1.—Fumaroles on south-east crater wall, showing steepness of crater-wall inside. [*F. Burlingham.*

By the courtesy of the British and Colonial Kinematograph Company and of Mr. Burlingham, NATURE is able to publish examples of the interesting photographs obtained during their enterprising undertaking. With two Neapolitans familiar with the mountain, Mr. Burlingham, who is an experienced alpine climber, reached

Copyright] [*F. Burlingham*
FIG. 2.—Showing "funnel" formed last July.

the lowest point of the funnel, the chief difficulties encountered being the danger from the sliding down of great loose masses and the powerful fumes of hydrochloric acid. The complete films, which are now being exhibited in London, are well worthy of being seen by all interested in science.

Fig. 1 is a view taken on the steep side of the crater, and shows near the top numerous fumaroles, arising probably from rain and snow-water penetrating to the heated materials. The stratified arrangement of the scoriæ and lava ejections is well shown in the photograph.

Fig. 2, taken lower down, shows the floor of the crater with the mouth of the funnel, and the vapour column rising out of it as seen from some distance above.

Fig. 3 is the view taken at the bottom of the funnel, with the masses of "incandescent pink vapours, in places exhibiting blue and other tints," rushing up from the bottom vent.

As Mr. Burlingham was able to convey apparatus exceeding 70 lb. in weight to the point shown in Fig. 3, it would seem possible to transport tubes and collecting vessels to the spot so as to obtain samples of the gases for analyses; gases thus obtained would not be subject to the objection that could be reasonably made to collections made from the fumaroles shown in Fig. 1.

We may, I think, rely on the enlightened director of the Reale Osservatorio Vesuviano, Prof. Mercalli, and his enterprising assistants not to lose sight of this opportunity for an important research.

Copyright] [*F. Burlingham.*
FIG. 3.—Where fresh lava was found, 1212 feet down at bottom of funnel, where pink incandescent fumes belch from the mouth which Prof. Mercalli discovered.

JOHN W. JUDD.

MIGRATORY MOVEMENTS OF BIRDS IN 1911–12.[1]

The report before us forms vol. xxxii. of the Bulletin of the British Ornithologists' Club, and is written on much the same lines as the former reports noticed in Nature. It affords a considerable amount of valuable information for those who are interested, and they are many, in the fascinating subject of bird-migration. The report is gradually growing, and the instalment for 1912 runs to no fewer than 335 pages. It seems to the writer that certain matter might well, indeed ought, to be omitted. This remark applies especially to the inclusion of practically the whole of the Scottish data for the autumn of 1911, which was published more than a year before by the Misses Baxter and Rintoul.

There are certain species of summer birds—and the marsh-warbler is one of them—about which we have insufficient data regarding the time of their appearance, and we might add departure. The species named is believed to be the latest of all summer migrants to arrive in England, and more information regarding its migrations would be most acceptable. Should not a special effort be made to obtain this? It is also very desirable to know—and this remark concerns all similar reports—on whose authority some of the species recorded are based. For example, who identified the rock-pipits recorded as occurring at the Outer Dowsing lightship in the earliest hours of the morning of March 20? Were wings sent as vouchers, or does the identification rest on the testimony of the light-keepers? Would it not be well to publish a list of all the wings received, or, perhaps better still, to star (*) the species the identification of which has been established by means of wings sent?

There are some *errata* in the report. Among them we note that the Scottish records for the occurrence of the common tern on the remarkably early dates of February 1, 4, and 24 are credited to the little tern! As last words, let us say that those who have not engaged in the preparation of similar reports have no idea of the vast amount of toil entailed. For this the members of the committee deserve our gratitude, in addition to our appreciation of the results of their labours.

W. E. C.

[1] Report on the Immigration of Birds in the Spring of 1912; also on Migratory Movements in the Autumn of 1911. (London: Witherby, 1913.) Price 6*s*. net.

SIR DAVID GILL, K.C.B., F.R.S.

David Gill, whose death occurred in London on January 24, was born at Aberdeen on June 12, 1843. At the age of fourteen he was sent to the Dollar Academy, where Dr. Lindsay's teaching imparted to him a fondness for mathematics, physics, and chemistry. He then proceeded to Marischal College and University, Aberdeen, where his love of science increased and developed under the inspiring influence of Clerk Maxwell. He would have liked a scientific career, but his father, a prosperous Aberdeen merchant, wished his son to succeed him. Gill consented with reluctance to enter his father's business, and consoled himself by devoting all his spare time to physics and chemistry.

His special interest in astronomy began in the year 1863, when it occurred to him that Aberdeen was in need of an accurate time standard, like the time-gun which Piazzi Smyth had introduced in Edinburgh. David Thomson, Professor of Natural Philosophy in King's College, Aberdeen, gave Gill a letter of introduction to Piazzi Smyth, whom he visited at Edinburgh, and there made his first acquaintance with an astronomical observatory. On his return to Aberdeen, with Thomson's assistance, an old disused observatory of King's College was refitted. Every clear evening Gill and Thomson went to the observatory and worked with the transit instrument. The observatory possessed a good sidereal clock, and a mean-time clock was obtained, to which contact springs were affixed, so that other clocks, including the turret clock of the college, were controlled by electric currents sent each second from the standard.

When the time-service had become a matter of routine, Gill purchased a silver-on-glass speculum of 12 in. aperture and 10 ft. focus. He himself designed an equatorial mounting, and the heavy parts were made to his working drawings in the workshops of a firm of shipbuilders in Aberdeen. The driving circle, its tangent screw, and slow motion were made by Messrs. Cooke and Sons, but the driving clock with a conical pendulum was made by Gill's own hands. With this instrument he made observations of double stars, &c., and took photographs of the moon. A copy of one of these photographs was recently presented by him to the Royal Astronomical Society, and is of great excellence.

About this time Lord Lindsay (afterwards the Earl of Crawford) was considering the erection of an observatory at Dun Echt. He called upon Gill to examine the instruments and methods he had used in obtaining his lunar photographs. The acquaintanceship soon ripened, and he learned of Gill's wish to devote his time entirely to science. It thus happened that in 1872 the Earl of Crawford offered to Gill the post of director of the observatory which his son was about to erect. Gill had married in 1870, and the acceptance of Lord Crawford's offer involved a considerable pecuniary sacrifice; but neither he nor his wife had any hesitation in gratefully accepting a post which was in such entire accordance with his tastes and interests.

The years 1872–74 were accordingly busily employed in cooperation with Lord Lindsay in the design and erection of the new observatory. Two of the instruments, the transit circle and 15-in. equatorial, were twenty years later presented to the Government, and formed the nucleus of the new Royal Observatory at Edinburgh. A third instrument was the 4-in. heliometer, which was afterwards used to such good purpose at

Ascension and the Cape. The details of these and other instruments were worked out, domes planned and built, and the telescopes mounted and brought into working order.

Lord Lindsay had arranged to observe the transit of Venus of 1874 in the island of Mauritius, and the task of determining the longitude of his station was assigned to Gill. Aden was connected with Greenwich by telegraph, but for the connection of Mauritius with Aden it was necessary to carry chronometers. No fewer than forty chronometers were taken and carried by Gill single-handed to their destination and back, a task of great anxiety and difficulty, especially at embarkation or landing at places like Suez, Alexandria, Aden, and Mauritius, where only coloured labour was available. A series of excellent determinations of longitude were obtained, and on the return journey the measurement of the base-line for the Egyptian Survey was made, the site selected being nearly in front of the Sphinx.

The expedition to Mauritius was memorable in another way. Though hampered by cloudy weather, Gill and Lindsay determined the solar parallax from a short series of heliometer observations of the minor planet Juno, and demonstrated the high value of this method. This was followed up by an expedition to the island of Ascension to utilise the opposition of Mars in 1877 for the same purpose. Gill having given up his connection with Dun Echt, Lord Lindsay granted him the loan of the 4-in. heliometer; the cordial support of the Royal Astronomical Society assured the necessary financial assistance, afterwards defrayed by the Government Grant Fund of the Royal Society. A delightful account of this expedition is given in "Six Months in Ascension, by Mrs. Gill—an unscientific account of a scientific expedition." An excellent determination of the solar parallax was obtained, and it was shown that for still higher accuracy it would be necessary to utilise the opposition of a minor planet owing to the observational uncertainty in setting on the limb of a planet with a perceptible disc.

On February 10, 1879, Gill was appointed H.M. Astronomer at the Cape. After a few months spent in visiting the principal observatories in Europe, he proceeded to the Cape, arriving there on May 26. The Cape Observatory had, under Gill's predecessors, Fallowes, Henderson, Maclear, and Stone, accomplished valuable work in the determination of the positions of the stars of the southern hemisphere. This important work, which falls naturally to large national observatories, was continued by him. He reduced and published the observations made by Maclear during the years 1849–52 and 1861–70, thus clearing off all arrears in the publication of the Cape observations. During his directorate he published catalogues of the fundamental stars observable at the Cape, of zodiacal stars the positions of which are required in heliometer and other observations of the moon and planets, and of 8560 stars to serve as reference points for the photographs in the section of the international photographic chart and catalogue undertaken by the Cape. He improved and carefully studied the details, such as pivot and circle errors, of the transit circle which had been erected in 1856. But he strongly held to the view that a reversible instrument was necessary for fundamental work of the highest accuracy, and when the purchase of such an instrument had been sanctioned by the Admiralty, threw his whole energy and mechanical and engineering skill into making the instrument the best of its kind. A brief account of its most striking features is given in NATURE for January 15, p. 556. It was only completed at the time of Gill's retirement from the Cape in 1906, but the results obtained by his successor, Mr. Hough, show that it has admirably fulfilled the object of high accuracy and freedom from systematic error.

Knowing what effective use he would be able to make of the 4-in. heliometer, Gill acquired it from Lord Crawford, and took it with him to the Cape. He employed it first in the determination of the parallaxes of nine southern stars which were remarkable for their great brilliancy or the size of their proper motions. In this task he was joined by Mr. Elkin, a young astronomer whose acquaintance he made at Strassburg in 1879. The valuable results obtained by the two observers were published in 1884. After the execution of the work, Gill pointed out to the Lords Commissioners of the Admiralty that a larger instrument was necessary for the further prosecution of research in stellar and solar parallax, and received their sanction for the purchase of a 7-in. heliometer. With the new instrument the parallaxes of twenty-two southern stars were determined with the highest accuracy. The work entailed extremely delicate and careful observations shortly after sunset and before sunrise extending over many months, and, in addition, laborious researches on the values and errors of screws and scale-divisions. This research, in which Gill's personal observations were supplemented by those of Finlay and de Sitter, has been recognised as the high-water mark of astronomical observation, and will probably never be surpassed by visual observations.

For the determination of the solar parallax Gill found that the minor planet Iris would be very favourably situated in 1887, and Victoria and Sappho in 1888. He determined to make observations himself, and secured promises of cooperation from other astronomers who possessed heliometers, and also of meridian observations to secure an accurate framework for the positions of the necessary reference stars. A very extensive programme was carried out, and the observations are discussed in two large volumes of the Cape Annals. The value of the solar parallax was found to be $8''\cdot804$, with a probable error of only $\pm 0''\cdot0046$. This result has been recently confirmed by the photographic observations of the planet Eros, and still more recently from the spectroscopic observations of the differences of the velocities of stars in the line of sight when the earth's revolution carries it to or from them. As a corollary to these important researches, the mass of the moon was determined from the displacement of the observer's position, arising from the movement of the earth about the centre of gravity of the earth and moon.

In 1882 photographs of the great comet were taken, under Gill's auspices, with an ordinary camera strapped on an equatorial telescope. Notwithstanding its small optical power, a surprising number of stars were shown in excellent definition over a considerable field. This suggested the possibility of employing similar but more powerful means for mapping the stars. Gill immediately took steps to obtain a suitable lens, and in January, 1885, having obtained 300*l*. from the Government Grant Committee, commenced a photographic *durchmusterung* of the southern sky. Prof. J. C. Kapteyn, of Groningen, volunteered to measure the photographs, and from the cooperation of the two astronomers a comprehensive survey of the sky was made from 19° S. declination to the south pole, containing more than 450,000 stars.

The photographs of this comet were fruitful in another manner. Copies of them, with a short explanatory note, were forwarded to Admiral Mouchez, the Director of the Paris Observatory, and were communicated by him to the French Academy. Their excellence led Admiral Mouchez to encourage the brothers Henry, who were engaged in charting the zodiac, to devote their attention to the construction of astrographic lenses. In this they had signal success, and after further correspondence between Gill and Mouchez, a conference was called at Paris in 1877 for the execution of an international chart and catalogue of the whole sky by photographic means. In this important work Gill took a keen interest and exercised great influence. He attended all the meetings of the Comité permanent in Paris, where he delighted to discuss with his colleagues the details of a great project which has been constantly advanced by his enthusiasm and energy.

Soon after Gill's appointment as H.M. Astronomer of South Africa, he laid before Sir Bartle Frere, who was Governor of Cape Colony and High Commissioner for South Africa, a comprehensive scheme for a geodetic survey of the country. His recommendations included a gridiron system of principal triangulation extending over Cape Colony, the Orange Free State, Natal, and the Transvaal. There were considerable delays at the start, but little by little the great project was carried out always under the unifying direction of Gill. In 1896 he suggested that the progress made in geodetic survey in South Africa should be regarded as a first step in a chain of triangulation which, approximately traversing the thirtieth meridian of east longitude, should extend continuously to the mouth of the Nile. He never lost any opportunity of forwarding this important geodetic project, and had the satisfaction of seeing the great arc of meridian measured from latitude 31° 36′ in the extreme south of Africa so far north as Lake Tanganyika in lat. 9° 41′.

Gill remained at the Cape as H.M. Astronomer for twenty-eight years. In this period he remodelled the fundamental meridian work of the observatory, introduced photographic astronomy, and achieved results of the highest importance with the heliometer. The generous gift of the Victoria telescope by Mr. F. McClean (a 24-in. photographic telescope with objective prisms and spectroscope) enabled work in astrophysics to be added to the activities of the observatory. In addition to the staff of the observatory, a number of astronomers were attracted to the Cape and worked there guided by Gill's counsel and stimulated by his enthusiasm. In this connection the names of Elkin, de Sitter, Cookson, and Franklin-Adams are readily recalled. In 1905 the British Association visited South Africa, and Gill had the greatest pleasure in showing them the great observatory which owed so much to him. The success of this memorable visit was largely due to the great respect and admiration entertained for Gill by the visitors from Europe and their hosts in South Africa.

He left the Cape in October, 1906, and took up his residence in London. His time was very fully occupied in writing the history and description of the Cape Observatory (see NATURE, January 15, p. 556), and in the activities of a number of scientific societies into which he entered with zest. He served on the council of the Royal Society, 1908–9 and 1910–11; on that of the Royal Astronomical Society from 1907–13, being president from 1910–12, and succeeding Huggins as foreign secretary in 1912; and on the council of the Royal Geographical Society, 1908–10 and 1911–12. He was president of the British Association at the Leicester meeting in 1907. He was constantly consulted by astronomers, particularly in the design of instruments. Another subject in which he was greatly interested was the manufacture of optical glass for large telescopes. His interests embraced not only the practical branches of astronomy and geodesy in which his own work had been done; he followed the recent researches in solar and stellar spectroscopy, in gravitational astronomy, and especially those bearing on the extent and movements of the sidereal system.

The signal services which he rendered to science were recognised by his creation as Knight Commander of the Bath, as Knight of the Prussian Order *Pour le Mérite*, and as Commander of the Legion of Honour of France. Honorary degrees were conferred upon him by the Universities of Oxford, Cambridge, Edinburgh, Aberdeen, Dublin, and the Cape of Good Hope. He was corresponding member of the leading academies of Europe and America. He received the Valz medal of the Institut of France in 1882, the gold medal of the Royal Astronomical Society the same year; the Bruce medal of the Astronomical Society of the Pacific in 1900, and the Watson medal of the National Academy of the United States in the same year; a royal medal of the Royal Society in 1903, and the gold medal of the Royal Astronomical Society a second time in 1908.

No biographical notice of Sir David Gill would be complete without some reference to his striking personality. His force of character enabled him to triumph over difficulties and carry out great projects. His enthusiasm and tenacity of purpose communicated themselves to his colleagues and assistants, and supported them and him in the arduous details inseparable from astronomical enterprise. But he never lost in these details a clear view of the ultimate purpose of his work. As an astronomical observer he was unsurpassed, the pleasure of making every measurement as accurately as he was able counterbalancing the tedium of making observations of similar character night after night. His engineering skill stood him in good stead, and the perfecting of his instruments was a constant source of delight to him. His administrative success was due in large measure to the confidence he inspired in his staff, and their regard for him both as an astronomer and as a friend.

His health had been excellent since his return to London, and his large circle of friends hoped that he would be with them for many years. He was suddenly seized with pneumonia in December, 1913, and passed away on January 24, after an illness of six weeks. We would tender to Lady Gill our respectful sympathy in her sudden bereavement. F. W. D.

Sir David Gill was laid to his rest on Wednesday, January 28, the funeral being at St. Machar Cathedral, Aberdeen. A memorial service was held at St. Mary Abbot's, Kensington, and was attended by a large number of personal friends as well as representatives of institutions of science and learning, among the latter being:—Prof. Forbes (Edinburgh University), Sir William Crookes and Sir Archibald Geikie (Royal Society), Sir Norman Lockyer (British Science Guild), Lady Lockyer (the Hill Observatory, Salcombe-Regis), Dr. F. W. Dyson, Astronomer Royal, Major E. H. Hills (Royal Astronomical Society), Colonel E. E. Markwick (British Astronomical Association), Prof. H. H. Turner (Oxford University, and, with Major MacMahon and Mr. O. J. R. Howarth, the British Association), Mr. H. F. Newall (Cambridge University), Major Leonard Darwin (Royal Geographical Society), Dr. R. T. Glazebrook (National Physical Laboratory and Optical Society), Dr. W. N. Shaw (Meteorological Office), Dr. P H. Cowell (Nautical Almanac Office), M. Jules Baillaud (representing the director of the Paris Observatory), Dr. A. E. H. Tutton (Mineralogical Society), Mr. W. H. Low (Cape Town Caledonian Society), Captain Lyons (the Science Museum), and Prof. Kapteyn (Groningen University).

DR. R. T. OMOND.

THE death of Dr. R. T. Omond at his house in Edinburgh on the morning of January 27 removes from us one whose name will be permanently associated with the famous Ben Nevis Observatory. Under his direct superintendence on that cloud-capped summit, hourly observations of the important meteorological elements were taken night and day for about ten years following 1884; and although his health prevented him doing the observational work for the remaining ten years of the great experiment, his whole mind was given to the completion of the undertaking. He continued as honorary superintendent; and devoted his time and energies to the reduction and discussion of the wealth of observations which had accumulated.

Dr. Omond was associated with Dr. Alexander Buchan in the preparation of the earlier of the four quarto volumes (Trans. R.S.E., vols. 36, 42, 43, 44) in which the observations are tabulated; but of the later volumes he had necessarily sole charge, and from the very beginning, indeed, the main labour of tabulation and proof correction rested with him. In addition to the tabulated observations of pressure, temperature, humidity, wind, rain, snow, &c., these volumes contain discussions and papers on various meteorological questions. There is also reproduced in detail the daily log-book of the observers, a fascinating and suggestive scientific document, containing, *inter alia*, descriptions of halos, glories, and coronæ, on which Omond himself contributed two papers to the Royal Society of Edinburgh. His principal scientific papers are published in the Ben Nevis volumes already mentioned, and in the *Journal of the Scottish Meteorological Society*.

Dr. Omond was educated at the Edinburgh Collegiate and at the University of Edinburgh. He did not follow any of the ordinary courses qualifying for degrees, but devoted himself mainly to study of physics under Prof. Tait, and to geology under Sir Archibald Geikie. He was, indeed, Tait's right-hand man in the investigations on the compressibility of fluids which arose out of the testing of the *Challenger* thermometers. He became a Fellow of the Royal Society of Edinburgh in 1884, was awarded the Keith Prize in 1892 for his Ben Nevis work, and served one term (1901–4) on the Council. The University of Edinburgh conferred on him the honorary degree of Doctor of Laws at the summer graduation of 1913. Hampered though he was latterly by a serious malady, he put through an immense amount of work, and retained to the end the bright, cheerful, unselfish spirit which endeared him to his many friends.

C. G. KNOTT.

NOTES.

WE record with much regret the death, on February 1, in his eighty-fourth year, of Dr. Albert Günther, F.R.S., formerly keeper of the zoological department of the British Museum (Natural History).

THE Postmaster-General has appointed a Committee to inquire into systems of high-speed telegraphy and to report thereon. The Committee will consist of Captain Norton, M.P., Assistant Postmaster-General (chairman), Sir John Gavey, C.B., Mr. J. Lee, Mr. W. M. Mordey, Mr. A. M. Ogilvie, C.B., Mr. W. Slingo, and Mr. A. B. Walkley. Anyone desirous of giving evidence before the Committee should communicate with Mr. G. O. Wood, Secretary's Office, G.P.O., who has been appointed secretary to the Committee.

A REUTER message from New York states that the Aëro Club has sanctioned a round-the-world aëroplane race, starting from the San Francisco Exhibition in May, 1915, and ending at the same place within ninety days. The first prize will be 20,000*l*. The race will be open to any type of motor-driven aircraft and will be under the auspices of the exhibition and the Pacific Aëro Club. It is announced that 30,000*l*. has already been subscribed, and that it is expected that an additional sum will be secured, all of which will be divided among the competitors.

IT has been decided to prepare for publication a biography of the late Sir William H. White, K.C.B., the eminent naval constructor. Mr. J. B. Capper, to whom the work has been entrusted, will be grateful for any material in the shape either of correspondence or of reminiscence throwing light upon Sir William White's personality or work. Letters will be carefully preserved, copied, and returned. Communications of all kinds should be addressed to Mr. Capper, care of Sir Henry Trueman Wood, secretary of the Royal Society of Arts, John Street, Adelphi, London, W.C.

AN address delivered by Mr. T. A. Jaggar, jun., at a meeting of the Hawaiian Volcano Research Association in Honolulu last December, has been published as a special bulletin of the Hawaiian Volcano Observatory. The address gives a detailed account of the nature and value of the scientific work done at the observatory. We notice that eleven investigators of note have been at Kilauea in the last five years, and have produced four important memoirs, many smaller papers, and a topographic map. A large realistic model of Kilauea is in preparation for the Agassiz Museum of Harvard University; and chemical analyses have been completed in Washington. In 1909 the late Dr. Tempest Anderson was in Hawaii, and secured many photographs. He presented the observatory with one of his ingenious cameras and a battery of three fine lenses. It is hoped, said Mr. Jaggar, that British friends will honour Dr. Anderson's memory by the establishment on St. Vincent, in the Caribbee Islands, of a permanent observatory and laboratory, for the study of the Caribbean volcanoes. This was his field of specially distinguished work in 1902.

THE Journal of the College of Science of the Imperial University of Tokyo was launched in 1887, and the Committee of Publication has recently issued a general index to vols. i. to xxv. (1887–1908). In this index there are fully 300 distinct contributions from about a gross of contributors, of whom twelve are Europeans and Americans. This gives some indication of the scientific activity of the Japanese, for all the contributions are of the nature of research. Every science is represented—mathematics, physics, chemistry, geology, mineralogy, zoology, botany, embryology, seismology, &c. The great majority of the papers are written in English, about two dozen being in German, a few in French, and three or four of the lists of plants in Latin. Many of the memoirs are recognised by those competent to judge as of first-class importance in the development of scientific knowledge. When it is remembered that the papers are to a large extent the result of research work by the teachers, students, and graduates of the College of Science, and in many cases of work done within its walls, the world will recognise that Japan is rapidly repaying her debt to the West, from whom she received her first impulse towards scientific investigation.

ATTENTION was directed in the issue of NATURE for March 6, 1913 (vol. xci., p. 20), to the Napier tercentenary celebration, to be held in Edinburgh on Friday, July 24 next, and following days. The celebration is being held under the auspices of the Royal Society of Edinburgh, on whose invitation a general committee has been formed, representing the Royal Society of London, the Royal Astronomical Society, the Universities of St. Andrews, Glasgow, Aberdeen, and Edinburgh, the University College of Dundee, and many other bodies and institutions of educational importance. The Royal Society of Edinburgh now gives a general invitation to mathematicians and others interested in this coming celebration. The celebration will be opened with an inaugural address by Lord Moulton of Bank, followed by a reception given by the Lord Provost, magistrates, and council of the city of Edinburgh. The historical and present practice of computation and other developments closely connected with Napier's discoveries and inventions will be discussed on the following days. Relics of Napier will also be on view, and it is intended to bring together for exhibition books of tables and forms of calculating machines, which may reasonably be regarded as natural developments of the great advance made by Napier. Individuals, societies, &c., may become founder members on payment of a minimum subscription of 2*l*.; and each founder member will receive a copy of the memorial volume, which will contain addresses and papers read before the congress, and other material of historic and scientific value. Ordinary subscribers attending the celebration may obtain copies of the memorial volume at a reduced price. Subscriptions and donations should be sent to the honorary treasurer, Mr. Adam Tait, Royal Bank of Scotland, St. Andrew Square, Edinburgh.

MR. J. C. DRUMMOND has been appointed assistant to the chemical department of the Research Institute of the Cancer Hospital (Free), Fulham Road, London, S.W.

AT the annual meeting just held of the Zoological Society of New York, it was resolved to cable to the Zoological Society of London the following message: "That the Zoological Society of New York, having been largely instrumental in securing the passage of our national measures for the protection of the birds of the world, by preventing all importations for purposes of fashion or millinery, hereby extends its greetings to its fellow-members of the Zoological Society of London, and expresses the hope that the society, which represents the other great metropolis of the world, will lend its unanimous support to the Hobhouse Bill, now before Parliament, which is designed to reinforce the protective measures passed by Congress. The effect of the American Bill has been instantaneous and widespread, and is now receiving unanimous support all over the United States. The very passage and enforcement of the Bill has created a sentiment for wild-life protection in many quarters where it did not exist before. The millinery trade has adapted itself to the new conditions, and the law is acknowledged to be most beneficial in its results."

WRITING on December 13, Prof. Ignazio Galli describes a series of sunset-glows which recall those of 1883–84. They were first observed in Rome on July 13, and continued without intermission, though with frequent variations in brightness, until the middle of December. Prof. Galli notices that on June 17, or about a month before their first appearance, there was a very violent explosion of the Asama-yama in central Japan, followed by others on June 20 and 26.

MR. E. O. WINSTEDT has done a piece of useful work by collecting in the Journal of the Gypsy Lore Society, new series, vol. vii., part i., all the references to gypsies in Tudor times recorded in the State Papers. They give, as he remarks, a picture of gypsy life when they travelled far and wide in large bands, some of the leaders of which bore names still well known. A band of 140 persons is recorded in Staffordshire in 1539; eighty in Berkshire, Oxfordshire, and Buckinghamshire in 1576, with a passport forged by a Cheshire schoolmaster. Active measures of repression were put in force by the authorities, an order of the Privy Council in 1542–3 directing certain persons "to avoyde the countrey off a certayne nombre off vagabondes going upp and downe in the name of Egiptians."

THE report of the bacteriologist, Prof. Ward Giltner, of the Michigan State Board of Agriculture for the year July 1, 1912–July 1, 1913, has been received. Soil problems bulk large in the record, and an extensive trial of a serum for hog-cholera is being made, more than 500,000 c.c. of the serum having been issued.

AMONG a collection of Antarctic seals and birds from South Georgia presented to the Scottish Zoological Park by Messrs. Salvesen and Co., Leith, the most interesting specimens are a couple of young elephant-seals, about 6 ft. in length, and a Weddell's seal. The latter is believed to be the first living example of its kind hitherto brought to Europe.

WITH reference to a paragraph in NATURE of December 16, 1913 (p. 457), Dr. W. D. Matthew writes to say that the so-called lions of the Rancho-la-Brea asphalt deposit are the extinct *Felis atrox bebbi*, and not pumas. The use of the term "lion" in this sense is to be deprecated, as it is commonly applied in America to the puma, while *F. atrox* appears to be as nearly related to the tiger as to the lion.

IN vol. xxxv (p. 252) of Notes from the Leyden Museum, Dr. J. H. Vernhout states that specimens of the limpet-like mollusc, *Siphonaria sipho*, have been taken on the coast of Ceram attached to rocks of mica-schist by the apices of their shells, so as to resemble small cups. Such a mode of attachment, so far as the author could ascertain, appears to be unique in the case of limpet-like shells.

THE extinct mammal-like reptiles of South Africa and their relatives in other parts of the world, together with the strata in which their remains are embedded, form the subject of a well-illustrated article by Dr. R. Broom in *The American Museum Journal* for December, 1913. A feature on which the author lays special stress is the powerful development of the limbs in nearly all the members of the group. "How these have been evolved is a matter of doubt, but there can be little question that it was this strengthening and lengthening of the limbs that started the evolution which ultimately resulted in the formation of the warm-blooded mammals."

To the first part of the "Bergens Museums Aarbok" for 1913 Mr. J. A. Grieg contributes an exhaustive article of 147 pages, illustrated with two plates, on the aquatic fauna of the Hardangerfjord, including both vertebrates and invertebrates. The second of the two plates is devoted to a life-size figure of the shell of a very large and much elongated form of the whelk (*Buccinum undatum*). In the second part is a systematic catalogue, by Mr. H. T. L. Schaanning, of the birds of Norway, with references to literature ranging from the year 1599 to 1912. The number of species recognised, inclusive of the great auk, is three hundred.

IN 1906 the late Dr. F. Ameghino described certain sharks' teeth from the Tertiaries of Patagonia as the representatives of a new generic type, Carcharoides, the name being given in allusion to the fact that these teeth have the sharply acuminate crowns characteristic of Lamna, associated with the serrated margins of those of Carcharodon. Teeth of a precisely similar nature from the Tertiaries of Victoria are described in *The Victorian Naturalist* for December, 1913 (vol. xxx., pp 142–3), by Mr. F. Chapman. The discovery is of interest as affording additional evidence of the close affinity between the Tertiary littoral faunas of Patagonia, New Zealand, and Australia, and thus lending support to the view that they inhabited different portions of a single sea-bed.

DR. ASAJIRO OKA, in the Journal of the College of Science, Tokyo (vol. xxxii.), describes a remarkable new Japanese compound Ascidian, to which he gives the name, *Cyathocormus mirabilis*. The form in question appears to be closely related to Colella, consisting of a "head" attached by a short stalk, but the head is hollow, with a wide terminal opening, so that the entire colony has the form of a goblet, in the wall of which a single layer of zooids are arranged in double longitudinal rows. The author proposes for the reception of his genus a new family, Cyathocormidæ, which he suggests may form a connecting link between the more ordinary Ascidiaceæ and the aberrant, free-swimming Pyrosoma. He therefore considers it doubtful whether we are justified in separating Pyrosoma from other compound Ascidians, and placing it along with Salpa and Doliolum in the Thaliacea, as has recently been done by Neumann and by Parker and Haswell.

It would be difficult to find a better example of the valuable work that can be accomplished by a local scientific society than is offered in the Transactions of the Norfolk and Norwich Naturalists' Society for 1912–13. The presidential address, by Mr. Robert Gurney, is concerned with "The Origin and Conditions of Existence of the Fauna of Fresh Water." He is of opinion that the fauna of the relict lakes of the world show that the isolation of marine fauna does not lead to any great accession to the fresh-water fauna. "It seems that the successful adaptation of a species to fresh water depends essentially on a physiological variation of the organism, without which the most favourable external conditions are powerless to assist immigration." Next comes a very careful, complete, and well-illustrated monograph, by Prof. Oliver and Dr. Salisbury, on the topography and vegetation of Blakeney Point, that hunting ground of naturalists, which has now been brought under the National Trust as a nature reserve. It is followed by Mr. A. Preston's notes on the great flood of August, 1912, which was of such disaster to Norwich. Then comes a very valuable instalment of Mr. C. Morley's "Fauna and Flora of Norfolk." Other shorter papers, well worth study, include those on the growing of wild rice in East Norfolk, on the migrations of birds from Lowestoft and district, and on the record results of the Yarmouth herring fishery of 1912. Altogether, these Transactions do honour to a great society of natural history, in a county favoured by nature and famous in science. Dr. Sydney Long, the hon. secretary of the society, is to be congratulated on the care with which he has edited this collection of monographs.

"The Geology and Mineralogy of Tin" are the subjects of a bibliography of 1701 entries, accompanied by an index of 167 pages, prepared for the Smithsonian Institution by F. L. and Eva Hess (Miscell. Collections, vol. lviii., No. 2). Since a brief account of the contents of almost all the papers is supplied, this publication will form a standard work of reference. It does not profess to be complete as regards works on the extraction and treatment of the ores, and hence we miss a reference to the ingenious test for cassiterite with hydrochloric acid and zinc, put forward, we believe, in West Australia in 1908.

Dr. John Ball, in Paper No. 29 of the Survey Department of Egypt (1913) describes the topography and geology of the phosphate deposits of Safâga. The district lies about 400 kilometres south-south-east of Suez, near the Red Sea. The phosphate deposits occur on either side of the Wadi Safâga at distances of from twelve to twenty-two kilometres inland. The phosphatic series consists of laminated grey clays with beds of calcareous phosphate and chert, lying between Upper Cretaceous limestones above and Nubian Sandstone below. There are three principal phosphate beds, all in the upper part of the series. These beds range from 1½ to 2 metres in thickness, and carry from 20 to 75 per cent. of tricalcic phosphate. The bulk of the phosphatic matter is in the form of loosely agglomerated phosphatic grit, which may have been derived from the breaking up of shells, the calcium carbonate of which has been partially converted to calcium phosphate by the action of soluble phosphate from the decomposition of the soft portions of sharks the teeth of which occur very abundantly. The phosphate content may have been raised subsequently by the leaching out of some of the calcium carbonate. The origin of the chert has not yet been ascertained. The deposits are being worked at the Um el Huetat mines by the Egyptian Phosphate Company.

The seventeenth *Rapport sur les variations périodiques des Glaciers* (*Zeitschrift für Gletscherkunde*, Band vii., Heft 1, p. 1) was published in September, 1912, with some unavoidable omissions. The supplement now added, Band vii. (1913), pp. 191–202, gives the information which had not then been received. It includes the glaciers on the north side of the Mont Blanc massif, those of the Maurienne, the Tarentaise, and Dauphiné, the Caucasus, the Altai, and North America, chiefly Alaska. In the first region two, Des Bossons and Du Tour, show a marked advance, another one is stationary, and the fourth observed is slightly retreating. Those in the other regions are either stationary or showing slight oscillations, or are still retreating, though not rapidly. The eighteenth *Rapport*, recently published (Band viii., p. 42), shows that, though the cold summer of 1912 has produced some effect, this is local, and comparatively small. Thus the information, as a whole, does not affect the conclusion to which that already received distinctly pointed, namely that the period of retreat, which has now lasted (at any rate in the Alps) for half a century, has not yielded generally, as might have been anticipated, to one of advance. The eighteenth *Rapport* includes the Pyrenees, where the glaciers mostly show signs of advancing, Norway, where the majority are receding, and North America, of which this is also true. Here the retreat is in some cases considerable, notably in that of the Grand Pacific Glacier, which has gone back 25 kilometres in thirty-three years. Besides these, the number contains some notes on Greenland glaciers, which, though necessarily incomplete, are interesting. They also show that the ice has receded in recent years.

We have received a copy of the U.S. Daily Weather Map for January 1, with the announcement that from that date the U.S. Weather Bureau began the publication at Washington of a weather map of the northern hemisphere, which will be printed on the reverse side of the usual morning weather chart. Although the number of reports is limited at present, and the observations are not all strictly simultaneous, the essential features of atmospheric circulation over that hemisphere are fairly well shown. Prof. Marvin points out that in the latter publication the rational units of the c.g.s. system are adopted; pressures are expressed in millibars (1000 millibars = 29·53 in.), and temperatures in absolute units (the temperature on the Centigrade scale increased by 273), on the ground that mathematical and dynamic studies of the motions of the atmosphere are possible only when such rational units are employed. It will be remembered that these units are already used in some of our Meteorological Office publications, and that it is proposed to adopt them in others. Also that the Weekly Weather Report now contains small-scale daily charts, including practically the whole of the northern hemisphere, excepting Alaska and the North Pacific Ocean. The action taken by the Washington Bureau will be welcomed as matter of prime importance.

NEW paths of physical knowledge form the subject of an address to the University of Berlin delivered by Prof. Max Planck on his appointment as principal. The address deals with the conservation of matter, space, and time, and the quantum hypothesis; it is printed by the Norddeutscher Buchdruckerei, S.W., Wilhelmstrasse, Berlin.

AN article by Mr. Charles Bright in the January number of *The Quarterly Review* discusses the question of inter-Imperial telegraphy, and the advantages and disadvantages of cable telegraphy as opposed to wireless telegraphy. Whilst in favour of the State taking over control of the Imperial wireless telegraph scheme (Mr. Bright advocated this many years ago), it is pointed out that an inter-Imperial telegraph system would be the most advantageous. The route suggested is from Blacksod Bay, on the west coast of Ireland, to Halifax (N.S.), with an intermediate station at Cape Bauld (Newfoundland), and a branch cable up the Gulf of St. Lawrence towards Montreal. The cost of this line is estimated to be 500,000*l.*, and should be borne by the Empire as a whole. Having laid the Imperial Atlantic cable, it is suggested that the gaps should be filled up in order to complete an all-British cable chain between the Mother Country and her outlying possessions. Attention is directed to the fact that all the existing Atlantic cables are in foreign hands, and it is recommended that steps should be taken to remedy this state of affairs, which, it is argued, would be extremely prejudicial to the British nation in the event of international disputes. It is maintained that a cable has an advantage over wireless telegraphy in its greater secrecy and effective working speed owing to the far less repetition involved, and also owing to its freedom from interruption from "atmospherics," which are still a source of trouble in all wireless work.

IN two papers published in *The Biochemical Bulletin*, vol. iii., No. 9, by Dr. Clayton S. Smith and Messrs. W. A. Perlzweig and William J. Gies respectively, the question of the inhibition of change in fish by cold storage is dealt with. It is shown that bacterial and chemical action can be entirely prevented by efficient cold storage, and that even after two years of such storage practically no change can be detected by chemical means in the nutritive value of the fish or in its taste or palatability.

THE January number of *The Popular Science Monthly* contains an article by Prof. Cyril G. Hopkins on the Illinois system of permanent fertility. In this system no potash is added to the soil in the form of purchased fertiliser, but provision is made for the liberation of the necessary quantity from the soil by the action of decaying organic matter ploughed under in the form of farm manure or crop residues, including clover or other legumes. Ground natural limestone is added when needed. Phosphorus is supplied in the form of ground rock phosphate, at least 1000 lb. per acre being added every four years. Special rotations are arranged to suit the case, either of the live-stock farmer or the grain producer, so as to maintain the nitrogen fertility at a maximum. Articles on the present status of cancer research, by Dr. Leo Loeb, and the mechanism of heredity, by Prof. T. H. Morgan, discuss problems which are of general interest.

A PAPER on amalgams containing silver and tin, by Messrs. Knight and Joyner, which appears in the Chemical Society's Journal (December, 1913), is of special interest in view of the widespread use of these amalgams in dentistry. Although solid solutions may be present in large proportions at higher temperatures, these disappear almost entirely below 70°, and the process of amalgamation at room-temperature is substantially that represented by the equation:—

$$Ag_3Sn + Hg \longrightarrow Ag_3Hg_4 + Sn.$$

The curious "ageing," by annealing at 100°, which reduces to less than one-half the amount of mercury taken up by the freshly prepared filings of the silver-tin alloy has been further studied. It has been shown that it is not due to oxidation, and that it is accompanied by a change of density, but the real nature of the process is still obscure.

THE Chemical Society's Journal for December, 1913, contains an important monograph by Profs. Bredt and Perkin on epicamphor. This substance, which is related very closely to camphor,

$$C_8H_{14}\begin{array}{l}\diagup CH_2\\ \quad | \\ \quad HO\end{array} \qquad\qquad C_8H_{14}\begin{array}{l}\quad CO\\ \quad | \\ \diagdown CH_2\end{array}$$

Camphor — Epicamphor

differs from it mainly in that the carbonyl group is contiguous to hydrogen on both sides,

$$\begin{array}{l}—CH—CO—CH_2—,\\ \quad\ |\end{array}$$

instead of $\begin{array}{l}—C(CH_3)—CO—CH_2—,\\ \quad |\end{array}$ and might be expected to produce greater activity in the molecule. Nevertheless it refuses to combine with hydrogen cyanide and brominates in much the same way as camphor itself. The physiological effects of epicamphor are vastly inferior to those of camphor; a favourable effect on the beat of the heart does not become apparent until the dose is four times stronger than in the case of camphor, and even then the effects produced are very transient.

MR. A. P. THURSTON gives an account in *Engineering* for January 30 of some experiments carried out by him at the East London College on the resistance of bars, struts, and wires in a current of air. Part of this research was the investigation of the shielding effect of one bar mounted in the direct path of another bar of identical length, shape, and size. The total resistance when the two bars are in contact is about three-quarters the resistance of one bar alone. As the gap is increased, there is at first a small decrease in the resistance. With a gap equal to the thickness of one bar, the total resistance is the same as when the bars are in contact, and becomes equal to the resistance of one bar alone when the gap is twice the thickness of one bar. With a gap of sixteen times the thickness, the total resistance is only 5 per cent. less than double the resistance of the single bar. It would appear from these experiments that the total resistance of struts, following in the same run of air and more than thirty times the thickness apart, may be assumed to be the same as the total resistance of the separate struts in a clear run of air.

The Vesterling Organisation Company, Clapham Junction, London, S.W., manufactures a convenient loose-leaf book, which has certain novel characteristics. By the use of a patent device in the back of the book it opens flat at any place. Specially made rings render the filing of new papers, or removal of old, simple and quick. The book will prove of real assistance to lecturers who use copious notes, and to all who have to preserve loose papers in a way which makes ready reference easy.

A 1914 supplement to their "General Apparatus Catalogue, 1910," has been issued by Messrs. Heynes Mathew, Ltd., of Cape Town. The new list of apparatus affords an instructive illustration of recent progress in South African education. The improved methods of teaching geography which have become established in this country, for example, are being taken up in South African schools, and a demand for material for lessons in practical geography is met by a section in the new catalogue being devoted to this subject. Similarly this firm is prepared to supply equipment for practical work in botany and other branches of science.

OUR ASTRONOMICAL COLUMN.

Planetary Observations at the Lowell Observatory.—In *Astronomische Nachrichten*, No. 4710, a telegram is published from Prof. Lowell relating to observations on the satellites of Saturn and on Martian features. With regard to the former it is stated, "Tethys and Dione variable, range quarter magnitudes, periods coincident with revolution." Relating to the latter, the telegram says:—"The full aperture of the 40-in. reflector of the Lowell Observatory only now equipped for visible work shows the canals of Mars as fine direct geometrical lines, thus corroborating the work of smaller apertures. This should dispose of the erroneous idea that [such] apertures do not disclose these remarkable features."

Wave-Lengths of Chromospheric Lines.—It was known soon after the event of the total solar eclipse of August 30, 1905, that Prof. S. A. Mitchell, who was in charge of the numerous spectroscopic instruments which were employed in the United States Naval Observatory eclipse expedition, had secured some most excellent photographs of the spectrum of the chromosphere. It is not until now, however, that the results of their reduction are published, and these are printed in the current number of *The Astrophysical Journal* (December 1913). The photographs discussed were secured with gratings, both parabolic and plane, and the present paper deals with the reduction of one photograph from each instrument for the purpose of giving chromospheric wave-lengths, intensities, &c., "with as great an accuracy as possible." This communication is finely illustrated with plates showing different portions of the photographs, and they are demonstrative of the very fine adjustment of the instrument during use. A very long table shows the wave-lengths compared with Rowland, and the heights of the chromospheric lines, the corresponding elements and intensities according to Rowland, chromosphere, arc, and spark. No fewer than 2841 lines are tabulated in the chromospheric spectrum, and this above many faint lines which were measured; no lines were included unless they were measured in two or more separate measurements. The paper is full of many interesting summaries of these chromospheric lines arranged according to elements, atomic weights, &c. The conclusions arrived at are important, but it is impossible to repeat them all here. Some of them are as follows:—The "flash" spectrum is a reversal of the Fraunhofer spectrum. The "flash" is not an instantaneous appearance, but the chromospheric lines appear gradually, the highest layers first, the lowest last. The "reversing layer," which contains the majority of the low-level lines of the chromosphere, is about 600 km. in height. Wave-lengths in chromospheric and solar spectra are practically identical, the chromospheric spectrum differing greatly from the solar spectrum in the intensities of the lines. The differences of intensity find a ready explanation in the heights to which the vapours ascend. The enhanced lines are especially prominent in the chromosphere, and these are said to become brighter mainly because at the heights to which they ascend the vapours are mixed with hydrogen at reduced pressure.

The Annual of the Bureau des Longitudes.—The annual published by the Bureau des Longitudes is familiar to all readers of this column, and the present issue for 1914 will no doubt be found as useful for reference as its predecessors. In addition to the usual astronomical, physical, and chemical data embodied in these small pages, will be found articles of astronomical interest. Thus M. Deslandres gives a *résumé* of solar physics, M. P. Hatt contributes a short article on the deformation of images in telescopes, while M. G. Bigourdan writes very fully on the day and its subdivisions, the hour-zones and the international association of the hour. The seventeenth meeting of the International Geodetic Association is described by M. B. Baillaud.

WHAT IS PSYCHO-ANALYSIS?

Perhaps the most important and startling scientific theory of modern times is that which Prof. Sigmund Freud, of Vienna, has formed to explain the workings of the human mind. Many thinkers, indeed, hail Freud as the Darwin of the mind, and consider that his views are destined to transform the science of psychology. He certainly has succeeded in explaining such obscure and widely differing phenomena as dreams, wit, the seemingly accidental mistakes in speaking and writing which people so often make, the obsessions and other symptoms found in a large class of mental diseases, and the spontaneous likes and dislikes which we all experience and find so puzzling, in terms of one single hypothesis. Put quite briefly, this is the hypothesis of "the unconscious mind," something quite distinct from that theory of the "sub-conscious," with which we have been so long familiar in psychology.

The unconscious mind is a legacy from our earliest years of childhood, and its mode of working differs very considerably from that of our mind in later life. A little child is dominated by its wishes and desires, and strives blindly and persistently to satisfy them. Many of these wishes are bound up with the intense love which it feels for its parents or its nurse. Later on, under the influence of education and training, it learns to suppress some of these wishes because they are in conflict with other interests and desires of which it is now capable, and which are more in harmony with ethical and conventional standards. It learns to face pain instead of turning away from it, and to abandon its wishes for the sake of higher aims, instead of clinging blindly to them. But the childish wishes have not been destroyed. They continue to exist in the mind, although their owner is no longer aware of them. They form the nucleus of the "unconscious." In later life similar conflicts may occur, and unacceptable wishes may be suppressed. If these happen to be analogous to the earlier ones, they join them, and so are themselves drawn into the unconscious, and continue to exist in the mind with undiminished intensity, although unable under ordinary conditions to come to consciousness. On the other hand, if they do not become associated with corresponding infantile wishes in the unconscious, they remain ordinary memories, and gradually fade away and lose their intensity as such memories do. They do not become unconscious, but merely sub-conscious, or, as Freud puts it, "preconscious."

This distinction between the "unconscious" and the "preconscious" is fundamental in Freud's theory. It is a distinction between two classes of memories. Those memories which, as described above, join the unconscious are said to be "repressed." They cannot return to consciousness unless the repressing force of the mind, which Freud calls the "censor," is overcome. They continue, however, to exist with undiminished vigour like the infantile wishes, and with these latter are the cause of the mystifying experiences of life to which we have already referred. They often cause the slips of the pen and slips of speech which befall us when our attention is distracted. In these cases the censor has been caught napping, as it were, and the unacceptable wish comes for a moment to the surface of the mind. Thus a lady, writing to a girl friend who had recently married a man to whom she herself was attached, ends the letter with the words, "I hope that you are well and unhappy." The malevolent wish here comes to unintentional expression. The symptoms of so-called functional mental diseases, such as hysteria, are invariably caused by repressed tendencies from the unconscious. A young girl suffering from hysteria shows the symptom of a tightly-clenched right hand which she is unable to open. By the method of psycho-analysis, which we have still to describe, the physician discovers that the cause of this is a serious adventure which had happened to the girl in early youth, and which she had persistently refused to tell to her relatives. The determination not to tell, which is now quite unconscious, for the girl no longer remembers anything about the past event or the circumstances connected with it, receives a *symbolic* fulfilment in the clenched hand. As soon as the physician brings back the memory, the hand unclenches and the girl is cured.

It has been suggested, with great show of reason, that Hamlet was a hysteric, and that the so-called mystery of Hamlet is due to the effect of unconscious feelings of love towards his own mother dating from his earliest childhood (of which he is now completely unaware, and his creators—Shakespeare and his authorities—likewise). Hamlet cannot take vengeance on his uncle because he himself in earlier years had wished his father's death, and this persisting wish in his unconscious mind now paralyses his actions. Only in this way, it is thought, can—*e.g.* Hamlet's soliloquy in Act iv., Sc. iv., after he has at last received overwhelming proof of his uncle's crime, be adequately explained:—

> "Now whether it be
> Bestial oblivion or some craven scruple
> Of thinking too precisely on the event,—
> A thought which, quarter'd, hath but one part wisdom
> And ever three parts coward,—I do not know
> Why yet I live to say 'this thing's to do,'
> *Sith I have cause, and will, and strength, and means,*
> *To do't.*"

This inability to act, expressed in the lines italicised, seems to have an adequate psychological explanation in the working of the repressed tendency just referred to, and its concomitant ideas, which Freud calls the "Oedipus complex." In the play of Sophocles, Oedipus unwittingly kills his father, Laius, and marries his mother, Jocasta, and this is a mythical representation of an inner mental tragedy overhanging each one of us, to which the hysteric, through mental weakness, succumbs.

The pleasure and amusement derived from some forms of wit may be explained as due to repressed and forbidden wishes which attain fulfilment in spite of the censor by means of the technique of the joke. Other forms of wit, though not so obviously related to repressed wishes, can likewise be explained in terms of Freud's general theory.

Finally, dreams are, in Freud's view, invariably the disguised fulfilment of repressed wishes. Harmless memories from the previous day, and from earlier periods of life, are manipulated by the dream-activity in such a way that they form a disguise for a repressed wish emanating from the unconscious, enabling the latter to evade the censor and thus come to consciousness during sleep. It would appear that sleep renders the censor less alert than he is during waking life, although if we passed beyond this metaphorical way of putting it we should come to a more profound theory much too difficult to describe, even in outline, here. The dream as it appears to the dreamer is simply a patchwork of memories of apparent unintelligibility, but underlying them are rational dream-thoughts corresponding to the fulfilment of repressed wishes. Often the dream represents the dream-thoughts symbolically, since this is a convenient way of evading the censor.

The method of interpreting any dream is identical with the method of interpreting a hysterical symptom or any other manifestation of unconscious ideas. Indeed, it is the one method whereby Freud has convinced himself of the existence of these unconscious ideas. This method is *psycho-analysis*. The dreamer or patient is asked to put himself into a relaxed and meditative frame of mind, and, starting from different parts of the dream, or different facts in the history of his mental disease, to observe and report faithfully the various ideas that arise spontaneously in his mind in connection with them, suppressing none of them, however objectionable or painful they may be. Experience shows that this method enables ideas in the unconscious to overcome the resistance of the censor and rise to consciousness. In the case of mental disease the bringing back of these repressed memories to consciousness involves the cure of the patient, since they can now be rationally faced and dealt with, and the mental energy that has been locked up in them, "fixated," can be liberated and put at the disposal of the higher conscious self.

Psycho-analysis is a lengthy process, demanding much tact and ingenuity from the psychologist or physician, but its results are of such surpassing interest and value that it should be regarded as one of the most important methods of mental science.

WILLIAM BROWN.

THE SURVEY OF INDIA.[1]

THIS general report for 1911–12, which has lately appeared, states concisely the progress made in the various departments of the Survey of India, the detailed descriptions and discussions of results being present in vol. iii. of the Records of the Survey. In the year under review, Colonel S. G. Burrard, F.R.S., was confirmed as Surveyor-General in succession to Colonel F. B. Longe. Topographical surveys were pushed on in various parts of the country, and work was done to meet some special requirements, of which may be mentioned the large-scale map of the Delhi site, with contours at 5 ft. vertical interval for the use of the town-planning committee. On the Geodetic Survey the astronomical latitudes of eleven stations were determined, and at one of these, Bihar, the largest southerly deflection of the plumb-line as yet found in India was found. Pendulum observations were made over the same region. In the principal triangulation the Sambalpur meridional series was commenced, and carried from lat. 23° to lat. 22°. In Kashmir secondary triangulation was carried along the Hunza and Kanjut valleys to form a connection with the Russian triangulation in the Taghdumbash Pamir.

The field detachments of the Magnetic Survey were employed on the detailed examination of the Deccan trap area in Central India and Hyderabad State, where considerable abnormalities exist. Comparative observations were made at the survey base stations, and a large number of repeat stations were visited for observation. In the Map Publication Office orographic colouring, by means of a series of colour tints from light green through yellows, browns, purples, and red, has been adopted for the one-millionth scale in place of shading as facilitating the provision of information. These sheets differ in size and in the unit (foot) of the vertical measurements from those of the international map, but as they form the key to the whole system of nomenclature and the arrangement of the topographical sheets, they cannot be dispensed with.

A series of "departmental papers" is to be commenced. These will be numbered serially, and will include all papers which, being published for departmental use, do not fall within the scope of the "Professional Papers," and are not of public interest.

Those, however, who are interested in the technical details of surveying will turn rather to the third volume of the Records of the Survey of India, where full accounts of this work will be found. Topographical surveys included triangulation, levelling, traversing, and detailed measurement on various scales from 1 in. to one mile, to 20 in. to one mile in cantonment survey. Many points of interest and modifications in procedure are noticed, among which we may mention the experimental use of Bristol boards instead of drawing paper on the plane-tables used in the field. If these are fastened firmly to the board by one edge only, and loosely by cloth slips on the other sides, the trouble arising from distortion of the sheet when working in very dry climate is greatly reduced. Further experience with these boards is awaited.

In geodetic work the use of a new and more powerful zenith-telescope is reported, and determinations of latitude were made with it at eleven stations. Of these all stations but one, Khajnaur, on the north side of the Siwalik Hills, the attraction of the plumb-line is southerly, the largest value being at Biharas, mentioned above. In the pendulum work, observations were made to the north of the Ganges in a region which showed unusually low density, and it is suggested that Rarachi, situated on the edge of the high plateau which forms the southern edge of the Ganges valley, may be near the crest of a ridge of high density. An important piece of work in this connection was an investigation of the isostatic theory of Mr. Hayford, with respect to a number of Indian stations, and the results obtained for the above-mentioned stations are given. In the account of precise levelling it is mentioned that experiments are being carried out with a new pattern of aluminium staff.

A full account of the magnetic survey and work in the observatories is given, but this calls for no special remark. In an appendix is given a synopsis of geodetic work near Dehra Dun, which is illustrated by a map showing the triangulation and gravity observation stations, as well as the lines of precise levelling. The whole volume forms a valuable contribution to the literature of high-grade surveying.

H. G. L.

[1] General Report on the Operations of the Survey of India during the Survey Year, 1911–12. Prepared under the Direction of Colonel S. G. Burrard, F.R.S., Surveyor-General of India. (Calcutta: pp. vii + 36 + 12 maps, 1913.) Price Two Rupees or Three Shillings.

"Records of the Survey of India." Vol iii., 1911–12. Prepared under the direction of Col. S. G. Burrard. Pp. 176+12 maps. (Calcutta.) Price 4 Re. or 6*s*.

THE ASSOCIATION OF TECHNICAL INSTITUTIONS.

THE twenty-first annual meeting of the above association was held at the Clothworkers' Hall, Mincing Lane, on January 30 and 31 last, and was attended by upwards of 120 delegates representing all the important technical institutions in the United Kingdom, of whom about ninety-seven are enrolled in the association.

The new president, Sir Alfred Keogh, K.C.B., on taking the chair, delivered his inaugural address, in which he dealt with the report of the Royal Commission on the reconstitution of the University of London, and especially with that part of it concerned with technological studies. He expressed great satisfaction with the position accorded to the faculty of technology in the proposals of the Commission, particularly with respect to the methods of administration and with the prominence assigned to the sphere of utility in educational questions.

The Commission recommended the establishment of a self-governing faculty of technology in the University, such faculty to embrace all branches of applied science. He dwelt upon the extreme importance of bringing the specialisation of science well within the sphere of the University, and expressed gratification that entrance to the University would be made more accessible to the fit student with greater freedom for the teacher.

Various questions of considerable importance to the well-being of technical institutions were considered. Amongst them, the registration of teachers and the proposals of the newly established Teachers' Registration Council. Great satisfaction was expressed with the happy solution of this extremely difficult question by means of which the profession of teacher had been unified, and it was unanimously agreed that it was desirable that all eligible members of the teaching staffs of technical institutions should seek enrolment.

The new regulations of the Board of Education dealing with junior technical schools were the subject of considerable discussion, and the view was generally expressed that all forms of specialised teaching should come within the scope of the new regulations, and that all limiting conditions as to the pupil's future outlook should be entirely removed from the regulations.

Special consideration was given to that section of the report of the Royal Commission which dealt with the examination of the external student desirous of proceeding to the degrees of the University of London. It was agreed that access to the examinations of the University should continue to be, as in the past, effectively provided for with such improvements in method as experience would suggest, but that no steps should be taken which should in any way diminish in standing or importance the quality of the degree awarded to the external student, or which should impair the position of the external as compared with the internal student. It was further strongly urged that there should not be, as proposed, any exclusion of unattached students from the examinations in technology, including engineering, in view of its disastrous effect upon higher technological education, and that it was of the utmost importance that the relations hitherto subsisting between the London polytechnics and the University of London should be maintained, and the recognition of eligible teachers in these institutions be continued.

The question of the new and important regulations for the establishment of technical bursaries by the "1851" Exhibition Commissioners with a view to the assistance of eligible graduates of the universities desirous of proceeding immediately to industrial employment was fully considered, and it was agreed that the Commissioners should be asked to consider the desirability of including within the list of accepted universities other qualified technical institutions.

The very important question of compulsory continued education in respect of children who had left the elementary schools to enter into employment with a view to their further education, both vocational and general, was carefully considered.

It was urged that having regard to the vast expenditure of public money, amounting now to upwards of twenty-four millions sterling per annum, and with a view to conserve the results of this expenditure, not only should "half-time" be abolished, but all regulations by means of which a child may be relieved of attendance at school before he reaches the age of fourteen, and that there should be enacted a law under which children leaving the elementary school at fourteen should be required to attend within the usual hours of labour a continuation school, which shall include in its curriculum not only vocational subjects, but such subjects of a general character as shall conduce to his effective preparation for the duties of life, and that the responsibility for the due observance of the law be laid upon the employers. It was shown that only a mere fraction of the children leaving school for employment continued their education, the figures being, for those between fourteen and seventeen years of age, only 300,000 out of a total of 2,335,000, or 13 per cent., with the result that there was a most serious economic and moral loss to the nation.

It was further shown that the German Government, realising this great loss to the German nation, had for some years established compulsory day continuation schools for children in employment throughout the empire, with most satisfactory results. There was a general consensus of approval. In the city of Berlin in 1910–11 there were 68,000 students of both sexes enrolled in continuation schools, of whom 32,000 were students in compulsory schools. J. H. R.

ANCIENT PIGMENTS.

IN *Archaeologia*, vol. lxiv., pp. 315–35, Prof. A. P. Laurie, of the Royal Academy of Arts, presents us with the chief results of an important research on the historical and local succession of the use of "ancient pigments." His material has been drawn almost entirely from western Europe, Chinese, Persian, and Indian painting not being discussed. His conclusions, derived mainly from the optical and microchemical examination, necessarily much restricted, of valuable illuminated MSS., amplify rather than correct those of previous investigators, such as Sir Humphry Davy, Marcelin Berthelot, and other chemists of the nineteenth century, but synthetic experiments have in some cases been utilised. The story more nearly approaches completeness in some sections than in others. The lakes, for example—pink, lilac, red, crimson, and purple—have not as yet, in all cases, revealed their origin. Perhaps the series and sequence of blue pigments may be cited as a characteristic example of Dr. Laurie's fuller treatment of his subject. Of the six blues included in the early list—indigo, Egyptian-blue, the mineral azurite or chessylite, real ultramarine from lapis lazuli, blue verditer and smalt—the most interesting is without doubt Egyptian-blue. To this remarkable pigment Prof. Laurie has devoted much attention, having finally determined its composition and properties, and also the *optimum* temperature for its production (see Proc. Roy Soc., vol. lxxxix. A, pp. 418–29). Although these six pigments were not all in use everywhere and at the same time they cover the early centuries and the period between classical times and the close of the sixteenth century. Later additions to blue pigments comprise Prussian-blue, near the beginning of the eighteenth century; cobalt-blue, and artificial ultramarine in the first quarter of the nineteenth century; and cœruleum about the year 1870. This dating of pigments and of their use is of the highest importance in connection with questions as to the provenance and authencity of works of art. For full details Prof. Laurie's paper, with the annexed tables, must be consulted. A few typographical errors in this important memoir should be noted; Robertson on p. 321 should be Roberson; sulphur not silver should appear in the second line from the bottom of p. 331; and the name of the mollusc from which the Irish monks prepared the Tyrian purple employed in their illuminated MSS. is not quite accurately given in the earlier of the tables appended to the memoir. It may be suggested that this purple pigment, which is a dibromoindigotin, ought to be identifiable where its presence is suspected by means of its high content of bromine.

A. H. C.

CELLULOID AND ITS DANGERS.

THE Departmental Committee on Celluloid, appointed by the Home Secretary some fifteen months ago to consider the precautions necessary in the storage and use of this substance, has recently issued its report (Cd. 7158, 1913). From this it appears that the product accepted as "celluloid" in the report consists essentially of gelatinised nitrocellulose and camphor, the proportion of nitrocellulose usually varying from 70 to 75 per cent. in ordinary celluloid articles, and from 80 to 90 per cent. in kinematograph films. It ignites very readily, and burns with great rapidity and fierceness; moreover, in certain circumstances it may take fire without the direct application of flame. If submitted to a moderately high temperature for some time it suddenly decomposes with evolution of considerable heat and the emission of inflammable and poisonous gases

—chiefly carbon monoxide and nitric oxide, with small proportions of hydrocyanic acid. Mixed with air in suitable quantity, the evolved fumes are highly explosive; but the Committee found no evidence to confirm the opinion that celluloid itself is liable to spontaneous ignition at ordinary temperatures or is explosive in ordinary circumstances.

A number of experiments were carried out at the Government laboratory for the information of the Committee. It was found that the "fuming-off" test devised by Prof. Will was the simplest and one of the most trustworthy methods for ascertaining the relative stability of various kinds of celluloid towards heat. No definite relation between chemical composition and stability to heat could be detected, though a small proportion of mineral matter appears to have a distinct stabilising effect. Celluloid contains sufficient oxygen to support its own combustion, and once ignited will continue to burn in the absence of air; chemical fire extinguishers using carbonic acid gas are, therefore, of little use, and water alone is the best means of extinguishing the substance when burning. The Committee makes a number of recommendations as to the storage and working of celluloid, with the view of lessening the danger from fire; for these the report itself should be consulted.

WIRELESS TELEGRAPHY.[1]

WHEN Mr. Marconi first came over to England in 1896, Mr. Swinton was the means by which he was introduced to Sir William Preece, and the latter, having just then come to the conclusion that his methods of inductive and conductive telegraphy—with which he had been attempting to effect communication with lightships—were unworkable, set the Post Office to work with Mr. Marconi, Sir John Gavey having charge of the experiments. It might seem strange, as Prof. S. P. Thompson had pointed out in NATURE, that Sir William Preece missed the possibilities of Sir Oliver Lodge's Hertzian-wave experiments, but took up Mr. Marconi with practically the same system. But Sir William Preece had always been particularly sympathetic to the young, and Sir Oliver Lodge had not approached him directly.

Next, quoting from an article which Sir William Crookes contributed to *The Fortnightly Review* in 1892, Mr. Swinton showed that Sir William Crookes had in those days fully realised the possibility of telegraphy by means of Hertzian waves. He clearly described how messages might be sent in Morse alphabet by means of apparatus tuned to special wave-lengths and receivable only by apparatus similarly tuned. Mr. Crookes also referred to experiments made by Prof. Hughes in 1879, where wireless signals were transmitted over several hundred yards, at which experiments he had assisted. There seems to be no doubt that Hughes discovered Hertzian waves and noted their effects some years before Hertz rediscovered them, but, unfortunately, Sir George Stokes told Hughes, apparently quite erroneously, that the results could be explained by known induction effects, and Hughes was so much discouraged that he never published anything on the matter.

Then, with reference to Sir Oliver Lodge, Mr. Swinton said that he would always regard him as the original inventor of wireless telegraphy, because Sir Oliver Lodge in his Royal Institution lecture in 1894, and later at the Oxford meeting of the British Association in the same year, had first publicly sent signals, rung bells, and deflected galvanometers over a distance by means of Hertzian waves. It had been said that Sir Oliver Lodge did not make clear the telegraphic application of his experiments, but Mr. Swinton was present at Lodge's Royal Institution lecture, and was so much impressed with the telegraphic capabilities it suggested, that he had next morning discussed with his then assistant, Mr. J. C. M. Stanton, the possibility of setting up communication between his residence in Jermyn Street and his office in Victoria Street by Lodge's method. This experiment was never tried, as they had thought that too many large buildings intervened, but preliminary experiments were made in Mr. Swinton's office, and signals on a bell were successfully transmitted and received through several walls with a large Tesla high-frequency coil used as transmitter, and as receiver a coherer consisting of a heap of tintacks. This was two years before Mr. Marconi arrived in this country, but in making these statements Mr. Swinton did not wish in any way to belittle the great work that Mr. Marconi undoubtedly accomplished in making wireless a practical and commercial success by long-continued and arduous labours.

Passing to his experiments, Mr. Swinton stated that finding a difficulty in reading wireless messages by ear, he had devoted attention to automatic recording apparatus. A simple arrangement that he had devised was to employ a sensitive or manometric flame, such as can be made exceedingly sensitive to minute sounds, the flame greatly shortening and roaring the moment the smallest sound reaches it.

Different descriptions of these flames respond more readily to sounds of different pitches, and they also can be tuned to some extent, so that different flames would discriminate between signals of different acoustical pitch even of the same electrical periodicity. All that was necessary was to place the receiving telephone in proximity to the sensitive portion of the apparatus producing the flame, and if a screen were placed in front of the latter hiding the flame when it was shortened, photographic records of Morse signals were easily obtained by throwing by means of a lens a small image of the flame when visible upon a moving strip of photographic paper. Another method of recording the signals employed by the lecturer was to arrange a quick-period mirror galvanometer with the movable portion oscillating between adjustable stops, the oscillations being recorded on a strip of moving photographic paper by projecting on the latter the reflection in the oscillating mirror of a bright point of light proceeding from a pinhole in an opaque box, containing an electric lamp.

Operating, as he did, at his own house, with a very small aërial, Mr. Swinton, in order to magnify the signals, made use of several relays of the types invented by Mr. S. G. Brown. He showed three of these relays connected in series, actuated by signals received on a temporary aërial that Messrs. Gamage had kindly erected on the roof of the Institution of Electrical Engineers. The relays operated a Kelvin siphon-recorder, as well as a loud-speaking telephone, which could be heard by everyone present. At a quarter to nine o'clock a special congratulatory message was received. This was sent by Commandant Ferrié, a vice-president of the society, from the Eiffel Tower. Not only could every signal be clearly heard throughout the Lecture Hall, but it was also received on the siphon-recorder. Further, the motions of the siphon were made visible to the audience, being optically projected on a screen with the aid of an Epidiascope, kindly lent by Messrs. Leitz and Co. The dots and dashes were easily read, both audibly and visibly, though the Admiralty in London was accidentally during part of the time sending radio-telegraphic signals, which were likewise made audible by means of the loud-speaking telephone. The message from

[1] Abstract of the presidential address delivered to the Wireless Society of London on January 21 by Mr. A. A. Campbell Swinton.

the Eiffel Tower consisted of thirty-four words, and occupied about seven minutes. A congratulatory message was also received and rendered audible to the audience from the London Telegraph Training College at Earl's Court.

Mr. Swinton also showed the working of an ordinary Morse inker by means of wireless signals from a distance. For this he employed the three Brown relays with a Siemen's Post Office relay in addition. The inker was modified by turning the magnets upside-down, so that when energised they pulled the inking wheel away from the paper tape, and the signals were recorded when the magnets let go of the armature instead of when they attracted it, as is the usual arrangement. Mr. Swinton had devised this method to get over the difficulty of the extra current, due to the relay breaking the magnet circuit, sending a wireless signal back to the whole apparatus. With the modified arrangement this extra signal took place while the main signal was being received, so it could only accentuate the latter and do no harm, whereas before the modification was effected, when once started, the Morse inker went on working by itself like an electric bell.

Next the lecturer showed how it was possible to receive wireless signals on a phonograph. In the ordinary way, records made by this method were not loud enough to be heard by an audience, but a small microphone had been mounted on the repeating diaphragm, and connected to a loud-speaking telephone, and by this means signals from the Eiffel Tower and from the Admiralty, which had been recorded on the phonograph, were made audible throughout the hall.

Once an arrangement of relays that would work a Morse inker was provided it became possible to operate almost any kind of apparatus, and wireless signals sent by the British School of Telegraphy at Clapham were made, by means of the relays and an electromagnet, to work an air-valve in connection with a source of air pressure and an organ pipe, which latter gave forth in long and short blasts the signals of the message. Mr. Swinton said that the same apparatus worked a motor-horn very effectively, but the horn could not be used indoors, as its noise upset the relays.

Next it was explained how a Poulsen telegraphone could be used as a recorder; and that on the Poulsen-Pedersen system an Einhoven "string" galvanometer was employed for this purpose. With this instrument a signal containing energy to the extent of only one billionth of a watt could be registered, which is about the same sensibility as what is obtainable with a Bell telephone receiver. On the assumption that a 12 candle-power light, radiating one watt in the form of visible electromagnetic waves, was visible at a distance of five miles, and that the aperture of the eye was one-fifth of a square inch, then the amount of power reaching the eye would be about one-sixth of one billionth of a watt, so that natural detectors like the eye, and artificial detectors, such as the Einhoven galvanometer, had about the same order of sensitiveness, and were much more sensitive than any photograph process for instantaneous effects, although photography had the advantage that cumulative effects could be obtained by long exposures. Some years ago Lord Rayleigh found that the human eye and ear were of the same order of sensitiveness.

Another matter mentioned by the lecturer was that the Eiffel Tower aërial, as also those at Poldhu and at other large stations, gave out loud sounds when messages were being transmitted, this being probably due to the air particles being electrified and repelled, as in a Brush discharge.

In his concluding remarks, Mr. Swinton speculated on the future of wireless. The chief difficulty at present with regard to wireless telephony is to get a microphone that would carry sufficient current without burning up, while there is also the necessity for switching over, when changing from receiving to transmitting, which renders conversation troublesome. These are, however, difficulties that should be got over, and it was probable that in the not far distant future, we should have statesmen wirelessly addressing numerous audiences simultaneously, while wireless receiving stations would be set up in connection with halls where people would be able to go and hear *viva voce* all the prominent speakers of the day. Further, wirelessly operated column printing telegraphs would tell the latest news to all the nation, as also to any newspapers which continued to survive this much more rapid method of disseminating intelligence. Again, if we are ever to have Transatlantic telephony, it would probably be wireless, with which the difficulties due to the capacity and self-induction of the cables are avoided.

Mr. Tesla and Prof. Pedersen even believe in the possibility of wireless transmission of power, and in this connection it must be remembered that practically all the power on our planet comes from the sun in the form of electromagnetic waves, and amounts, on a clear day, to no fewer than 4,500,000 horse-power per square mile of the earth's surface. This is, at any rate, good evidence that enormous amounts of power can be transmitted over prodigious distances by means of electromagnetic waves, but it is difficult to imagine how efficiency could be obtained.

Finally, Mr. Swinton appealed to the romance attendant on the spectacle of great liners hurrying across the ocean to the assistance of a ship from whom they had just heard in wireless whispers the S.O.S. signal of distress.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies will shortly proceed to appoint a University lecturer in mathematics and a Cayley lecturer in mathematics in succession to Dr. Baker, the new Lowndean professor, who held both of these posts.

Mr. A. H. Cooke, of King's College, and Mr. H. H. Thomas, of Sidney Sussex College, have been approved by the General Board of Studies for the degree of Doctor of Science.

The council of the Senate have issued an important report on the admission to University lectures and laboratories of men who are not members of the University. The success of the diplomas in agriculture and in tropical medicine and in other subjects, has led to a considerable increase in the number of students, not members of the University, who are using the University laboratories and lecture-rooms. It is proposed in future to keep a register of such students and to charge each of them a small fee.

MR. L. G. SUTTON has given a donation of 1000*l.* to the fund which is being raised to provide adequate buildings and laboratories for the agricultural and other departments of University College, Reading.

THE sixteenth annual dinner of the City and Guilds College Old Students' Association will be held at the Trocadero Restaurant, Piccadilly Circus, W., at 7.30 p.m., Saturday, February 21. Dr. G. T. Moody, president of the association, will occupy the chair. Tickets may be obtained by any old student of the college from Mr. G. W. Tripp, 4 Fairfield Road, Charlton, Kent.

THE legacies of the late Lord Strathcona include the following to educational institutions:—St. John's College, Cambridge (in addition to 10,000*l.* given during his lifetime), 10,000*l.*; the Royal Victoria College, Montreal (under deduction of any payments made during his lifetime, and in addition to the college buildings and site provided by him at a cost of about 80,000*l.*), 200,000*l.*; Yale University, Connecticut, U.S.A., 100,000*l.*; the University of Aberdeen for chair of Agriculture, 5000*l.*; Queen's University, Kingston, Canada, extension fund, 20,000*l.*; the principal Church of Canada Presbyterian College, Montreal, 12,000*l.*

THE second volume of "Statistics of Public Education in England and Wales" for 1911–12–13 has been published by the Board of Education (Cd. 7204). It is concerned wholly with financial statistics. The first table in the volume shows that the total expenditure of the Board of Education in 1912–13 out of the Parliamentary vote amounted to 14,329,551*l.*, as against 14,302,859 for 1911–12. During 1912–13, 11,748,331*l.* was spent on public elementary schools, 749,359*l.* on secondary schools, 585,871*l.* on technical schools and classes, and 583,127*l.* on the training of teachers. Among other grants made by the Board during the financial year mentioned were 41,647*l.* to university institutions in respect of technological work, 35,000*l.* to the Imperial College of Science and Technology, as compared with 20,000*l.* in 1911–12, 17,790*l.* to the Science Museum at South Kensington, 20,590*l.* to the Geological Survey, and 2202*l.* to the Committee on Solar Physics.

THE annual report of the distribution of grants for agricultural education and research in the year 1912–13 (Cd. 7179, price 8½*d.*), recently issued by the Board of Agriculture and Fisheries, shows a very satisfactory advance on the older state of affairs. The new scheme made possible by the establishment of the Development Fund has now been in operation for a sufficient number of months to prove that it is in the main very satisfactory, and can accomplish the work it was intended to carry out. The general plan is set out very lucidly in an introduction by Mr. T. H. Middleton, and a number of details are given in the appendix, so that the reader can form a sufficient idea of the scheme and its working. For the first time scientific research is recognised as the starting point, and the sum of about 30,000*l.* per annum is, or will be, available for the research institutes that have been set up; in addition 3000*l.* per annum is granted for special investigations not quite falling within the scope of the research institutes. These institutes are not charged with the investigation of specific local problems or with the elaboration of technical details; their business is to elucidate the fundamental principles underlying the relationships of the soil, the plant, and the animal, and they have a perfectly free hand in the management of their affairs. They are:—Imperial College of Science and Technology, for plant physiology and pathology; Agricultural Department, Cambridge University, for animal nutrition and for plant breeding; Rothamsted Experimental Station, for soil problems and plant nutrition; Bristol University, for fruit growing; Royal Veterinary College, for animal pathology; University College, Reading, for dairying; University of Birmingham, for helminthology; University of Manchester, for economic entomology; University of Oxford, for agricultural economics.

THE annual general meeting of the Royal College of Science Old Students' Association was held at the college on January 31, the president (Dr. A. E. H. Tutton, F.R.S.) in the chair. Prof. H. E. Armstrong, F.R.S., was elected president for 1914, his place as one of the vice-presidents being filled by the election of Mr. A. T. Simmons. Mr. J. Allen Howe and Mr. C. Ll. Humberstone were re-elected treasurer and secretary respectively. After the regular business, the report of the Royal Commission on University Education in London was discussed, with special reference to the recommendations relating to the college, and the following resolutions were adopted unanimously:—(1) That the Imperial College of Science and Technology should be organised as a federation of colleges under a common government, each college being managed by a special committee; (2) that the Royal College of Science, the Royal School of Mines, and the City and Guilds (Engineering) College should be included in the federation, together with a fourth college devoted to higher teaching and research in Technology; (3) that if, and when, the Imperial College is linked more closely with the University of London, the Royal College of Science, London, should, while remaining in the proposed federation of colleges, become a "constituent college" of the University in the faculty of science. The committee was empowered to make representations under these resolutions. The annual dinner of Old Students was held in the evening at the Criterion Restaurant, Dr. Tutton presiding. Sir John Rose Bradford, Sec.R.S., proposed the toast of the evening, "The Royal College of Science, London, and the Old Students' Association," and Sir William Ramsay, F.R.S., and Prof. S. J. Truscott replied for the guests. The guests also included Dr. Herringham (Vice-Chancellor of the University), Sir Alfred Keogh, K.C.B., Mrs. Ayrton, Prof. Bateson, F.R.S., and Dr. Frank Heath.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 29.—Sir William Crookes, O.M., president, in the chair.—Prof. O. W. **Richardson**: The origin of thermal ionisation from carbon. In a paper recently communicated to the society by Dr. J. N. Pring, experiments bearing on this subject were described. The smallness of the observed currents and the variation of them with the pressure and nature of the gas, led Dr. Pring to the conclusion that considerable doubt was thereby cast on the theory of the emission of electrons from hot solids, and that these effects were to be attributed to chemical action. In the present paper the magnetic field due to the large heating currents employed by Dr. Pring are shown to curl up the paths of the electrons, and so prevent them from reaching the electrode. It is shown that with the larger currents none of the electrons could reach the electrode in these experiments, and owing to the complexity of the apparatus it is impossible to say what proportion would reach it at the lower temperatures. In the opinion of the author of this paper, the conclusions referred to cannot be regarded as established by the experiments under consideration.—Prof. W. H. **Bragg**: The X-ray spectra given by crystals of sulphur and quartz. A crystal of quartz is found, on examination by the X-ray spectrometer, to contain three interpenetrating hexagonal lattices of silicon atoms and six of oxygen. The angles of reflection in a number of important planes all agree, within 1 or 2 per cent., with the calculated values. Sulphur contains eight interpenetrating lattices, each of the kind formed by placing an atom at each corner of a rectangular parallelopiped and in the centres of two opposite faces. The edges of the parallelopiped are in the known ratios of the crystallographic axes.—Prof. L. N. G. **Filon**: The temperature variation of the photo-elastic effect in strained glass. The experiments described in this paper were undertaken to see whether the double refraction produced in glass by stress was at all affected by change of temperature. The results show that the refractive indices for rays polarised in and perpendicular to the line of stress are unequally affected, but seem increased on the whole by rise of temperature. One of these, however, shows a permanent residual change even after cooling. This is important as showing that this property of the glass is affected by previous temperature treatment.—J. H. **Shaxby** and Dr. E. Emrys **Roberts**: Studies in Brownian movement. Paper i., The Brownian movement of the spores of bacteria.—Dr. R. **Whiddington**: The transmission of kathode rays through matter.—Ezer **Griffiths**: The variation, with temperature, of the specific heat of sodium in the solid and liquid state; also a determination of its latent heat of fusion. The specific heat of sodium (melting point 97·6°) was investigated at various temperatures in the range 0° to 140° by the electrical method. The range of temperature through which the metal was heated was about 1·5°, thus enabling the actual specific heat at each particular temperature to be determined. In the solid state the specific heat is considerably influenced by the nature of the previous heat-treatment, and two distinct specific heat-temperature curves are obtained for the annealed and the quenched state. The increase in the values of the specific heat in the solid state is very marked as the melting point is approached. In the molten state the specific heat decreases with temperature, the relation between specific heat and temperature from 100° to 140° being linear. The latent heat of fusion was found to be 27·52 gram calories.—Dr. G. **Green**: Natural radiation from a gas. The investigations of Planck have established the result that the total energy emitted from a black body at any temperature consists of discrete quanta, all equal and similar. If we identify the "energy quantum" as the energy contained in the light pulse emitted each time a molecule undergoes structural change, the determination of the form of this light pulse might lead to useful information regarding the constitution of the molecule. In this paper the form of pulse, in which the energy per wave-length is the same as that required by Planck's law of radiation at any temperature, is first derived. This form accordingly represents the total radiation from any black body at any temperature. The radiating body is now taken to be a gas. By decomposing the above pulse we obtain an infinite succession of wave-trains emitted by the various groups of molecules obtained by arranging the total number according to speed.—Dr. T. E. **Stanton** and J. R. **Pannell**: Similarity of motion in relation to the surface friction of fluids. The paper deals with an experimental investigation of the existence of the similarity of motion in fluids, of widely differing viscosities and densities, in motion relative to geometrically similar surfaces, which has been predicted from considerations of dynamical similarity by Stokes, Helmholtz, Osborne Reynolds, and Lord Rayleigh.—A. E. **Oxley**: The influence of molecular constitution and temperature on magnetic susceptibility.—N. **Eumorfopoulos**: The boiling point of sulphur on the thermodynamic scale.

Challenger Society, January 28.—Sir John Murray in the chair.—C. Tate **Regan**: A bathypelagic angler-fish (*Melanocetus johnsoni*), from the North Atlantic, having inside it a Scopeloid fish (*Lampanyctus crocodilus*) three times its own length. The specimen was taken at the surface of the sea, and it was supposed that the struggles of the captured fish, before it was completely swallowed, had brought the captor up from the depth at which it normally lives. Curiously enough, the only other examples of Melanocetus in the British Museum, two in number, were of nearly the same size (3 in. long), and each contained a Lampanyctus of 8 or 9 in.—G. P. **Farran**: The Copepoda of a set of serial tow-nettings from the west coast of Ireland. In gatherings taken over a series of years at ten-mile intervals on a line running sixty miles west of co. Kerry, out of eighty-five species that occurred, four were neritic and showed a uniform decrease both in numbers and frequency of occurrence at every ten miles from the shore. Sixty-six were oceanic, and showed a uniform increase seawards over the same stations, while twelve species varied irregularly and seemed to be euryhaline.

MANCHESTER.

Literary and Philosophical Society, January 13.—Mr. F. Nicholson, president, in the chair.—W. **Cramp**: Some notes on the measurement of air velocities, pressures, and volumes. The author described the instruments generally used, and the results he obtained with a special apparatus he set up for testing them. His results were summarised as follows:—(1) For accurate tests of fans, &c., a Brabbée tube and a micromanometer, or a good facing gauge with a side gauge having its orifice flush with the pipe wall and used with a micromanometer, are far more accurate than the older methods. (2) The pneumometer may be specially useful where the air is laden with dust, &c. (3) The Nipher collector is very inaccurate. (4) In ordinary round or square pipes the coefficient of contraction is rarely less than 0·9.

PARIS.

Academy of Sciences, January 26.—M. P. Appell in the chair.—The **President** announced the death of Sir David Gill, correspondant for the section of astronomy.—G. **Bigourdan**: The determination of the thermometric coefficient of the wire micrometer. The method recently devised by M. Lippmann for the autocollimation of a telescope can be utilised for the rapid and accurate determination of the focal length of the objective of the telescope, and this, combined with the measurement of the linear value of one turn of the micrometer screw and the coefficient of the wire gives a solution of the problem.—G. **Humbert**: Some remarkable numerical functions.—H. **Deslandres** and A. **Perot**: Contribution to the realisation of high magnetic fields. Concentration of the ampere-turns in a very small volume. The method is partly based on the use of a stream of petrol cooled to −30° C. by a liquid ammonia machine, for cooling the wire carrying the current of the electromagnet, and partly on a modification of the winding of the electromagnet. The field thus obtained was 51,500 Gauss, with a current of 24 amperes.—E. **Roux**: Remarks on antigonoccic vaccines. A reference to the work of P. Mayoral and P. Grandez bearing on the recent publication of C. Nicolle and M. Blaizot on the same subject.—M. **Gambier**: Bertrand's curves and curves of constant curvature.—E. **Keraval**: A family of triply orthogonal systems.—H. **Andoyer**: New fundamental trigonometrical tables.—Th. **Anghelutza**: The left symmetrical nucleus in the theory of integral equations.—Ernst **Lindelöf**: Conformal representations.—Georges **Rémoundos**: The convergence of series of analytical functions.—A. **Châtelet**: Congruences of higher order.—G. **Armellini**: The analytical solution of the limited problem of three bodies.—M. **Swyngedauw**: The resistance of safety spark-gaps.—Eugène **Darmois** and Maurice **Leblanc**, jun.: The possibility of an alternating arc in mercury vapour. It was shown by Cooper-Hewitt that the mercury arc in a vacuum acts as a valve for an alternating current, and this has been utilised for conversion of alternating into continuous current. The authors describe conditions under which it is possible to maintain an alternating arc in mercury vapour for low frequencies and moderate voltages.—G. **Moreau**: Flames containing chlorides giving an electromotive force.—MM. **Hanriot** and **Lahure**: The minimum temperatures of annealing. The time during which the metal is heated to a given temperature has a considerable influence on the softening of the metal. The experiments were carried out on zinc and silver.—Marcel **Delépine**: The iridium chlorides.—Michel **Longchambon**: The rôle of magnesia in sedimentary cycles.—Maurice **Durandard**: The ferment of *Rhizopus nigricans*. The mycelium of this mould contains a very active ferment: its action on milk is a maximum at 50° C.—Raoul **Combes**: The presence of yellow pigments capable of being transformed into anthocyanine in leaves and flowers not forming anthocyanine.—Henri **Piéron**: The decrease of the ratio of the latent period to the period of total establishment for luminous sensations as a function of the intensity of stimulation.—Henri **Bierry** and Albert **Ranc**: The proteid sugar of the blood plasma.—M. **Lécaillon**: The analogies of structure which exist betweent the ovary of certain insects and that of certain Branchipodids (*Chirocephalus stagnalis*).—L. **Joleaud**: The geology of the Filfila djebel (Algeria).—J. **Repelin**: The geological constitution of the septentrional part of the department of Var.—René **Nicklès**: The section of the Lias, the Infralias, and the Trias of Lorraine in the boring of Bois Chaté. This boring was made for coal, and penetrates to the Upper Permian. No coal-bearing strata were found.

BOOKS RECEIVED.

Forty-second Annual Report of the Local Government Board, 1912–13. Supplement containing the Report of the Medical Officer for 1912–13. Pp. lxx+412. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s*.

A Text-book of Domestic Science for High Schools. By M. G. Campbell. Pp. vii+219. (London: Macmillan and Co., Ltd.) 4*s*. net.

Descriptions of Land. By R. W. Cautley. Pp. ix+89. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*. net.

Annuaire pour l'an 1914, publié par le Bureau des Longitudes. Pp. vii+502. (Paris: Gauthier-Villars.) 1.50 francs.

Ueber Gedächtnis, Vererbung und Pluripotenz. By Prof. V. Haecker. Pp. 97. (Jena: G. Fischer.) 2.50 marks.

Indian Administration. By Prof. V. G. Kale. Pp. iv+298. (Poona: Arya Bhusham Press.) 1.4 rupees.

Der Fischerbote. vi. Jahrgang. No. 1. (Hamburg: L. Friederichsen and Co.)

Zur Frage der Entstehung maligner Tumoren. By Prof. T. Boveri. Pp. 64. (Jena: G. Fischer.) 1.50 marks.

The Religious Revolution of To-day. By Prof. J. T. Shotwell. Pp. ix+162. (Boston and New York: Houghton, Mifflin Co.) 1.10 dollars net.

Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band xlviii. Pp. vii+347+iv plates. (Zürich: Zürcher und Furrer.)

Finlandisch Hydrographisch-Biologische Untersuchungen. No. 12. Jahrbuch 1912. Enthaltend Hydrographische Beobachtungen in den Finland Umgebenden Meeren. Edited by Dr. R. Witting. Pp. 130+vi plates. (Helsingfors.)

R. Osservatorio di Catania. Catalogo Astrofotografico 1900, o Zona di Catania. Vol. iv., Parte 1. Pp. 153. (Catania.)

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. ii., part 9. (Sydney: W. A. Gullick.) 2*s*. 6*d*.

Columbia University in the City of New York. Publication No. 7 of the Ernest Kempton Adams Fund for Physical Research. Neuere Probleme der Theoretischen Physik. By Prof. W. Wien. Pp. 76. (Leipzig und Berlin: B. G. Teubner.)

The Cancer Problem. By C. E. Green. Third edition. Pp. 98+plates. (Edinburgh and London: W. Green and Sons.) 5*s*. net.

Experimentaluntersuchung zur Messung von Erderschütterungen. By Prof. L. Grunmach. Pp. 102. (Berlin: L. Simion, Nf.) 5 marks.

Report of the Department of the Naval Service for the Fiscal Year ending March 31, 1913. Pp. 128+plates. (Ottawa: C. H. Parmelee.) 10 cents.

A Manual for Masons, Bricklayers, Concrete Workers and Plasterers. By Prof. J. A. van der Kloes. Revised and adapted to the Requirements of British and American Readers by A. B. Searle. Pp. xii+235. (London: J. and A. Churchill.) 8*s*. 6*d*. net.

A Handbook of Wireless Telegraphy. By Dr. J. Erskine-Murray. Fifth edition. Pp. xvi+442. (London: Crosby Lockwood and Son.) 10*s*. 6*d*. net.

An Algebra for Preparatory Schools. By T. Dennis. Pp. viii+155. (Cambridge University Press.) 2*s*

The Reform of the Calendar. By A. Philip. Pp. xiii+127. (London: Kegan Paul and Co., Ltd.) 4*s*. 6*d*. net.

Das Susswasser-Aquarium ein Stück Natur im Hause. By C. Heller. Zweite Auflage. Pp. vi+186. (Leipzig: Quelle und Meyer.) 1.80 marks.

Leitfaden für Aquarien- und Terrarien-Freunde. By Dr. E. Zernecke. New edition. By C. Heller and P. Ulmer. Pp. ix+456. (Leipzig: Quelle und Meyer.) 7 marks.

Methodik und Technik des naturgeschichtlichen Unterrichts. By Prof. W. Schoenichen. Pp. xiv+611+30 plates. (Leipzig: Quelle und Meyer.) 12 marks.

The Principle of Relativity in the Light of the Philosophy of Science. By P. Carus. Pp. 105. (Chicago and London: The Open Court Publishing Co.) 4*s*. net.

The Mechanistic Principle and the Non-Mechanical. By P. Carus. Pp. iv+125. (Chicago and London: The Open Court Publishing Co.) 4*s*. net.

Allen's Commercial Organic Analysis. Fourth edition. Edited by W. A. Davis and S. S. Sadtler. Vol. viii. Pp. x+696. (London: J. and A. Churchill.) 21*s*. net.

The Examination of School Children. By Prof. W. H. Pyle. Pp. v+70. (London: Macmillan and Co., Ltd.) 2*s*. net.

Zellen- und Gewebelehre. By Prof. K. von Bardeleben. Zweite Auflage. Pp. 96. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Entwicklungsgeschichte des Menschen. By Dr. A. Heilborn. Pp. viii+87. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Das Mikroskop. By Prof. W. Scheffer. Zweite Auflage. Pp. vi+100. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Das Meer: seine Erforschung und sein Leben. By Prof. O. Janson. Pp. iv+113. (Leipzig und Berlin: B. G. Teubner.) 1.25 marks.

Handbook of Photomicrography. By H. L. Hind and W. B. Randles. Pp. xii+292+plates. (London: G. Routledge and Sons, Ltd.) 7*s*. 6*d*. net.

Lectures on the Icosahedron and the Solution of Equations of the Fifth Degree. By Prof. F. Klein. Translated by Dr. G. G. Morrice. Second edition. Pp. xvi+289. (London: Kegan Paul and Co., Ltd.) 10*s*. 6*d*. net.

Ambidexterity and Mental Culture. By Dr. H. M. Jones. Pp. 102+plates. (London: W. Heinemann.) 2*s*. 6*d*. net.

The Birmingham Country. Its Geology and Physiography. By Prof. C. Lapworth. Pp. 53+maps. (Birmingham: Cornish Bros., Ltd.) 2s. 6d. net.

Yorkshire Type Ammonites. Edited by S. S. Buckman. part xii. (London: W. Wesley and Son.) 3s. 6d.

Contour Hand Maps. Coloured. Surrey, Glamorganshire, Hertfordshire, Kent, London, Middlesex, Northumberland, Oxfordshire. (London: G. W. Bacon and Co., Ltd.) 2d. net each.

Transformisme et Créationisme. By Prof. J. L. de Lanessan. Pp. 349. (Paris: F. Alcan.) 6 francs.

Incandescent Electric Lamps and their Application. By D. H. Ogley. Pp. x+107. (London: Longmans and Co.) 2s. 6d. net.

The Trail of the Sandhill Stag. By E. Thompson Seton. Pp. 93. (London: Hodder and Stoughton.) 3s. 6d. net.

An Account of the Morisonian Herbarium in the Possession of the University of Oxford, together with Biographical and Critical Sketches of Morison and the two Bobarts and their Works, and the Early History of the Physic Garden, 1619–1720. By Prof. S. H. Vines and G. C. Druce. Pp. lxviii+350. (Oxford: Clarendon Press.) 15s. net.

The Observer's Handbook for 1914. Edited by C. A. Chant. Pp. 72. (Toronto: Royal Astronomical Society of Canada.)

Heaton's Annual. The Commercial Handbook of Canada and Boards of Trade Register, 1914. Pp. 590. (Toronto: Heaton's Agency; London: Simpkin and Co., Ltd.)

DIARY OF SOCIETIES.

THURSDAY, February 5.

Royal Society, at 4.30.—The Conduction of the Pulse Wave and the Measurement of Arterial Pressure: Prof. F. Hill, J. McQueen and M. Flack.—Report of the Monte Rosa Expedition of 1911: J. Barcroft, M. Camis, C. G. Mathison, F. Roberts and J. H. Ryffel.—Some Notes on Soil Protozoa. I: C. H. Martin and K. Lewin.—The Development of the Starfish *Asterias rubens* L.: J. F. Gemmill.—The Floral Mechanism of *Welwitschia mirabilis* (Hook): Dr. A. H. Church.

Royal Institution, at 3.—Types and Causes of Earth Crust Folds: Sir Thomas H. Holland, K.C.I.E.

Linnean Society, at 8.—The Vegetation of White Island, New Zealand: W. R. B. Oliver.—Lantern-slides of Cape Plants, mostly in their Native Habitats: W. C. Worsdell.—The Range of Variation of the Oral Appendages in some Terrestrial Isopoda: W. E. Collinge.

FRIDAY, February 6.

Royal Institution, at 9.—The Mechanics of Muscular Effort: Dr. H. S. Hele Shaw.

Geologists' Association, at 7.30.—Annual Meeting.—President's Address: The Wearing Down of the Rocks. II.: Dr. J. W. Evans.

Institution of Civil Engineers, at 8.—Ancient Surveying: R. C. S. Walters.

MONDAY, February 9.

Royal Geographical Society, at 8.30.—Our Present Knowledge of the Antarctic and the Problems that Remain to be Solved: Prof. Edgeworth David, C.M.G., F.R.S.

TUESDAY, February 10.

Royal Institution, at 3.—Animals and Plants under Domestication: Prof. W. Bateson.

Royal Anthropological Institute, at 8.15.—Psychology of Magic: Prof. Carveth Read.

Institution of Civil Engineers, at 8.—The New Harbour Works and Dockyard at Gibraltar: A. Scott.

WEDNESDAY, February 11

Royal Society of Arts, at 8.—The History of Colour Printing: R. A. Peddie.

THURSDAY, February 12

Royal Society, at 4.30.—*Probable Papers:* Chemical Action that is Stimulated by Alternating Currents: S. G. Brown.—The Effect of the Gangetic Alluvium on the Plumb-line in Northern India: R. D. Oldham.—Note on the Origin of Black Body Radiation: G. W. Walker.—The Transmission of Electric Waves along the Earth's Surface: Prof. H. M. Macdonald.—Transparence or Translucence of the Surface Film Produced in Polishing Metals: G. T. Beilby.—A Method of Avoiding Inaccuracy due to Weight Errors in "Fixing" a Gold Coinage Standard Trial Plate: A. O. Watkins.—A Thermomagnetic Study of the Eutectoid Transition Point of Carbon Steels: Dr. S. W. J. Smith.—Note on Osmotic Pressure: W. R. Bousfield.

Royal Institution, at 3.—Types and Causes of Earth Crust Folds: Sir Thomas H. Holland, K.C.I.E.

Concrete Institute, at 7.30.—The Differential and Integral Calculi for Structural Engineers: W. A. Green.

Royal Society of Arts, at 4.30.—Khorasan: the Eastern Provinces of Persia: Major Percy M. Sykes.

Institution of Electrical Engineers, at 8.—Some Railway Conditions governing Electrification: R. T. Smith.

FRIDAY, February 13.

Royal Institution, at 9.—Production of Neon and Helium by Electric Discharge: Prof. J. Norman Collie.

Royal Astronomical Society, at 5.—Anniversary Meeting.

Physical Society, at 8.—The Moving Coil Ballistic Galvanometer: R. Ll. Jones.—Vibration Galvanometers of Low Effective Resistance: A. Campbell.—Vacuum-tight Lead-seals for Sealing-in-wires in Vitreous Silica and other Glasses: Dr. H. J. S. Sand.

Malacological Society, at 8.—Annual Meeting.—Presidential Address: Some Points and Problems in Geographical Distribution: Rev. A. H. Cooke.

Alchemical Society, at 8.15.—Some Notes on the Doctrine of the First Matter, with Special Reference to the Works of Thomas Vaughan: Sijil Abelul-Ali.

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Royal Institution, at 3.—The Electric Emissivity of Matter. I.: The Metals: Dr. J. A. Harker.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*" To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

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THURSDAY, FEBRUARY 12, 1914.

A GERMAN INTRODUCTION TO THE STUDY OF MIMICRY.

Mimikry und Verwandte Erscheinungen. By Dr. Arnold Jacobi. Pp. ix+216. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 8 marks.

THE scope of the work before us is sufficiently indicated by a list of its main sections. A brief general introduction is succeeded by a division of the subject under nine heads:—(i.) Protective Colouring; (ii.) Protective Resemblance; (iii.) Warning Colours; (iv.) Mimicry or Protective Imitation; (v.) The Imitation of Aculeate Hymenoptera, or "Sphecoidie"; (vi.) The Imitation of Ants, or "Myrmecoidie"; (vii.) The Imitation of Beetles; (viii.) Mimicry in Lepidoptera; (ix.) The General Characteristics of Mimetic Lepidoptera. Some of the principal memoirs in the literature of the subject are named in a short list at the end of the volume, but anything like a complete treatment is manifestly impossible in a work of this size.

Protective colouring (Schutzfärbung) and protective resemblance (Schützende Aehnlichkeit) are the terms employed by the author for the two kinds of cryptic colouring which have been called general and special protective resemblance. In the first the animal seems to melt into its surroundings; in the second it resembles some actual object. No mention is made of Thayer's interesting combination of the two principles in animals with a general obliterative colouring upon which are represented the details of the normal environment. Nor is there any reference to the same naturalist's brilliant interpretation of the white under-sides of animals.

The criticism, urged on p. 8, that we do not *know* whether the cryptic appearance is truly advantageous and really exists for the eye of the insect-eater can only be fully met by increased knowledge. In the meantime it is obvious that certain birds do hunt for their prey over tree-trunks that are not swept bare, even after many months of intermittent searching, but still harbour sufficient pupæ to keep up the average numbers of the species. We know too that birds will assemble in order to feed, when insects which must ordinarily be searched for are driven out by a grass fire or by "Driver" ants on the raid. And no one who has watched the pursuit of a cryptically coloured moth by birds in the immediate neighbourhood can doubt that it would have been attacked when at rest if only it had been seen.

The resemblances of the Membracidæ to thorns, bark, &c., is dismissed by the author (p. 15) as examples of "Museum Mimicry," for the very inadequate reason that these Homoptera are "mighty jumpers," and when disturbed "disappear after the manner of the flea." Well-concealed species are generally swift in their movements when they are disturbed. Furthermore, W. A. Lamborn has shown that the dark, bark-like West African Membracids are ant-attended when found on green stems. Companies of individuals are always found on old bark, as are females engaged in egg-laying—a very prolonged operation, lasting from thirty-six to forty-eight hours, during which the insect clings tenaciously to the egg-mass and is with difficulty disturbed (Trans. Ent. Soc., 1913, pp. 494–7). The author admits the wonderfully ant-like appearance of some tropical American Membracids, but rejects an interpretation based on the theory of mimicry because ants run and Membracids jump. The idea of a second line of defence does not seem to have occurred to him; and yet in nearly all the examples he accepts there *is* a second line, depending on powers of flight very different from those of the model.

The author has evidently taken considerable pains in studying the work that has been done in this country and expresses regret that his compatriots have not taken a larger share in it. There is, however, one subject which has escaped him, viz., the power of individual adjustment to the colours of the environment as exhibited by insects. On this power he can find nothing in English except "a meagre experiment . . . on butterfly pupæ"! (p. 25). The present writer is, moreover, bound to disclaim the honour of having influenced some of the names that are here set down—for example, the late Thomas Belt, whom he never had the pleasure of seeing, but to whom, for the "Naturalist in Nicaragua," he owes a deep debt of gratitude. Although the author writes with generous appreciation of British work, and appears to agree with its general tendency, he differs strongly from many conclusions on special points, and offers criticisms which it will be a pleasure to attempt to meet on some future occasion.

It is satisfactory to find the recognition, on p. 35, of a fact often forgotten—"that even the protective adaptation which is apparently the most perfect does not give security against detection—that creatures thus equipped have their special foes which can find them out, at least when driven by hunger." Similarly the polymorphism of the leaf-butterflies, Kallima, &c.—a stumbling-block to many—is clearly explained. "This multiplicity of patterns is the very thing which assists the efficiency of the leaf imitation, since the faded, dried, half-rotten leaf occurs in nature in a thousand forms and colours, with its transition from green to yellow and brown, its slits and jags, its traces of gnawing and of mould and fungi" (p. 37). And the objection, sometimes raised by those who have not sufficiently considered the subject, that a Kallima may be seen resting with expanded wings on green foliage is also effectively answered on p. 39.

For Warning Colours and in other parts of the book the author accepts the terminology introduced in this country in 1890. Haase's term, "Immunity" is wisely used only in a restricted sense. The unqualified word, carrying with it the assumption that the bearers of warning colours are exempt from all attack, even by parasitic foes —an assumption carefully guarded against on p. 52—gives an entirely mistaken impression. That such insects have their special enemies has now been shown by many observers. A good example is the highly conspicuous *Acraea zetes*, of which Dr. G. D. H. Carpenter collected in Uganda seventy pupæ and full-fed larvæ, but only reared sixteen butterflies. All the others—77 per cent. of the whole—were destroyed by parasitic insects.

The theory of aposematic or warning colours is considered to stand on a much firmer foundation than that of cryptic colouring (p. 50); but the author, accepting the conclusions published in the Proceedings of the Zoological Society in 1887, recognises the intimate relationship between the two. "Aposematic species restrict the food available for insect-eaters" and must therefore "pass on to other non-protected species the onus of satisfying the hunger of their foes. Now, if these, by any process of development, also attained immunity, the foe would be compelled to overcome his disgust, and accept the disagreeable food, and thus the advantage of the warning colour as an advertisement would be reversed, for it would facilitate the discovery of the prey" (p. 52).

The treatment of terrifying markings is inconsistent. They are ridiculed on p. 23, but taken seriously on pp. 56–59. It must be freely admitted that markings which make so strong an appeal to the imagination require to be tested and re-tested by carefully observing their effect upon enemies, before the bionomic meaning can be accepted as proved. This can scarcely be claimed at present for any examples except the terrifying Sphinx larvæ, the objects of superstitious fear by man in different countries, and proved by four observers to excite fear in animals. This, the clearest example, is doubted by the author, although he accepts the far more problematical interpretation of the markings and attitude of the eyed hawkmoth (*Smerinthus ocellatus*) as terrifying. Such an interpretation is probably correct, but before accepting it we require at least as much evidence as has been collected for the larvæ.

In the historical account of mimicry a common error is repeated. H. W. Bates himself, in his classical memoir (Trans. Linn. Soc., vol. xxiii., 1862, p. 495), grouped together the phenomena of mimicry and protective resemblance, and did not, as stated on pp. 60, 61, understand the former "as referring only to similarity in form and colour between creatures of different systematic position."

It is well-nigh impossible to get rid of an error of this kind when once it has been fairly started. However, we must do our best. Bates, on pp. 508–10 of his paper, quotes numerous examples of procryptic resemblance to twigs, bark, lichen, the excrement of birds and caterpillars, dewdrops, &c., concluding with the words, on p. 510: "I think it will be conceded that all these various kinds of imitative resemblances belong to the same class of phenomena and are subject to the same explanation. The fact of one species mimicking an inanimate object, and another of an allied genus a living insect of another family, sufficiently proves this." A footnote on pp. 508–9 is even more conclusive; for the actual term "mimicry" is applied to the procryptic examples. Referring to Rössler's interpretation of the buff-tip moth in the resting attitude, Bates adds in a note: "In an article on resemblances between insects and vegetable substances (*Wiener Entomol. Monatschrift*, 1861, p. 164), the author enumerates many very singular cases of mimicry; he also states his belief that the mimicry is intended to protect the insects from their enemies." The convenient restriction of the term mimicry to the resemblances to other specially defended animals—the models—came later, and is due to Wallace.

Returning to the author's section on mimicry, we notice a simple and convenient device for representing the mimetic association between two species, the names being connected by an arrow pointing in the direction of the model.

In the sub-section on "Mimicry among Batrachians" there is an interesting footnote on p. 75, suggesting the specific identity of the conspicuous, distasteful amphibian, which, as the author says, "hops about in all Darwinian literature as 'Belt's Frog.'" The species, he thinks, "can be nothing but *Atelopus varius*, which is extremely common in Central America." My friend, Mr. G. A. Boulenger, however, does not entirely agree with this conclusion. "It is quite possible," he writes, "that Belt's frog was *Atelopus varius*, Stannius, but it is more probable that it was *Dendrobates typographus*, Keferstein (*ignitus*, Cope), which occurs also in Nicaragua. All the *Dendrobates* appear to be very poisonous."

The section on mimicry of ants—one of the most important in the work—is enriched by an excellent summary, on pp. 114–23, of Wasmann's splendid researches.

Vosseler's account of the life-history of the Locustid *Eucorypha fallax* is given at considerable length and illustrated, on pp. 107–12. An ant-like larval stage of this insect was described long ago as *Myrmecophana fallax* by Brunner von Wattenwyl, and it is most satisfactory that Vosseler's excellent observations have now put this often-quoted example of mimicry in its true position. He shows that "after the fourth change of skin" there is "a change from a mimetic to a cryptic appearance," the succeeding stage being leaf-like in colour and exhibiting a correspondingly altered behaviour. The change thus begun continues to the end, the winged imago being beautifully leaf-like. In correspondence with these changes Vosseler does not admit that any feature in the likeness is unnecessary. And yet this was one of the very cases on which Brunner founded his conception of "hypertelic" resemblance, or resemblance that attains an altogether unnecessary perfection in detail—that is, in fact, "too good to be true."

The illustrations, especially those that are coloured, are rather rough, but they are, on the whole, well selected and serve their purpose. It is a pity that the two species of Heliconius figured on pp. 144 and 145 were not accompanied by *Melinaea imitata* and *Mel. ethra*, instead of *Mechanitis doryssus* and *Mech. lysimnia* respectively. If room could be found for only one Ithomaeine, there is no doubt that Melinaea should have been the genus selected. The mimetic females of the African *Papilio dardanus* are so complicated that much care is required to avoid mistakes. It is unfortunate that the only characteristic eastern and south-eastern Danaine model, *Amauris echeria*, and mimetic form (*cenea*) of *dardanus* should be described on p. 163 as West African.

But when every criticism has been urged, we must admit that the book will be very useful. Haase's important monograph is too large and expensive to be likely to reach many hands, and we welcome the appearance of a German work of small price and moderate size, which will serve as an introduction to this interesting and much-debated subject.

E. B. P.

TEXT-BOOKS OF CHEMISTRY.

(1) *General Chemistry Laboratory Manual.* By Prof. J. C. Blake. Pp. x+166. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 8*s*. net.

(2) *Practical Chemistry.* Qualitative Exercises and Analytical Tables for Students. By the late Prof. J. Campbell Brown. Sixth edition. Edited by Dr. G. D. Bengough. Pp. 78. (London: J. and A. Churchill, 1913.) Price 2*s*. 6*d*. net.

(3) *Organic Chemistry for Students of Medicine.* By Prof. J. Walker, F.R.S. Pp. xi+328. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd, 1913.) Price 6*s*. net.

(4) *Quantitative Analysis in Practice.* By Prof. J. Waddell. Pp. vii+162. (London: J. and A. Churchill, 1913.) Price 4*s*. 6*d*. net.

(5) *La Catalyse en Chimie Organique.* By Paul Sabatier. Pp. xiv+255. (Paris and Liège: Librairie Polytechnique, Ch. Beranger, 1913.) Price 12.50 francs.

(1) THE exercises in this manual are complementary to the author's "General Chemistry: Theoretical and Applied," and accordingly the work can scarcely be recommended to chemical students in general unless they are taking a course very similar to that planned by the author. About one-half of the book, which is interleaved throughout with blank pages for students' notes, is devoted to simple experiments, partly qualitative and partly quantitative, dealing with the chemistry of non-metallic ("acid-forming") elements. The experiments on the metals ("base-forming elements") might serve as an introduction to inorganic qualitative analysis, but would be of slight educational value unless accompanied by a course of lectures on the theory of analysis. A few simple experiments on the atmosphere, the soil, fuels, and oils, natural waters, the ferrous metals, and rocks are grouped under the heading of applied chemistry.

(2) This treatise, like the foregoing manual, is chiefly of interest as affording an indication of the subject-matter chosen for experimental study in the author's practical classes. These exercises are preceded by the following general instruction: "After performing each of the following exercises, the student should record the reactions in his notebook in the form of equations whenever an equation is possible." This excellent instruction, if conscientiously obeyed by the student and carefully supervised by a sympathetic demonstrator, would go far towards making the work educational. Yet without previous knowledge gained either from text-books of general chemistry or from lectures on the theory of analysis, the student

would scarcely be in a position to express the reactions in the form of equations. The explanations given in the text are fragmentary, and sometimes obscure and even misleading. This lack of information is specially noticeable as regards the action of solvents. No explanations are given of the solvent action of ammonium chloride on the hydroxides of magnesium and manganese, or of the changes which occur on dissolving silver chloride in ammonia, potassium cyanide, or sodium thiosulphate. It is extremely doubtful whether the reducing action of alkaline stannous chloride on bismuth hydroxide leads to the sub-oxide Bi_2O_2, or whether the interaction of potassium cyanide and copper salts gives rise to the double cyanide $K_2[(CN)_4Cu]$. Some explanation seems desirable for the instruction (pp. 24 and 39) to use "stale $NH_4.HCO_3$." On the whole, however, the working instructions are quite practicable, but, in the section devoted to the rarer elements, a distinction might, with advantage, have been made between tests requiring considerable concentrations and those appreciable even in very dilute solutions. Cerium dioxide (p. 27) is not red unless contaminated with other rare earths. The final sections of the book are devoted to organic qualitative analysis, including tests for a typical series of organic acids and the characteristic reactions of the principal organic bases with separation tables for the commoner alkaloids.

(3) In order to meet the requirement of students of medicine whose time for the study of chemistry may not exceed six months, the author has selected the chemical substances considered in the course chiefly on account of their medical interest. A novel feature in the work is the postponement of the consideration of nitrogenous compounds to the last third of the book. In spite of the condensation necessary in the circumstances, the author has succeeded in giving adequate explanations of several important and difficult subjects, such as stereoisomerism, the chemistry of the naturally occurring sugars, the cyanogen derivatives and organic amines, including alkaloids. In other shorter sections a more sketchy outline has been regarded as sufficient, but the subjects are always dealt with so suggestively that the work can be recommended as a useful introduction to the study of organic chemistry not only for medical students, but also for others requiring a general outline of the subject dealing with substances of practical interest.

(4) An introductory course of quantitative analysis in which the author lays special stress on the speed with which analytical work should be carried out. Thoroughly practical directions are given for carrying out fifteen typical exercises, and the time required for completing these analyses is indicated in each case. The analytical processes are connected with the general chemical principles underlying these operations. For example, the precipitation of magnesium ammonium phosphate affords an opportunity for discussing the chemistry of phosphoric acid and its salts. In the separation of nickel and cobalt, considerable saving of time would be effected by substituting for the double nitrite method the processes based on the use of nitroso-β-naphthol or dimethylglyoxime. The appendix contains useful sections on the chemical balance, calibration, electrolyte dissociation, and indicators.

(5) This work is a valuable *résumé* from the pen of one whose name will remain inseparably linked with the subject of "Catalysis in Organic Chemistry." The introductory chapter dealing with autocatalysis and negative catalysts is followed by sections devoted to the general survey of substances utilised as catalysts in organic chemistry, catalytic oxidations and hydrolyses, and the catalytic introduction into organic molecules of halogens, sulphur, metals, and the carbonyl and sulphonic groups. Five chapters are devoted to the important subject of catalytic hydrogenation. Although the action of metals in accelerating the addition of hydrogen to organic and inorganic substances had been known since the commencement of the nineteenth century, the systematic study of this process, which was first initiated by the author and Senderens in 1897, has since led to the development of a valuable general reaction in organic synthesis based on the employment of finely divided nickel. Due reference is made to the special processes of hydrogenation devised by Ipatieff, Paal, and Willstätter. The action of the metallic catalyst in inducing the reverse change of dehydrogenation has also been demonstrated by the author and by Zelinsky and others. In collaboration with Mailhe, the author investigated systematically the dehydrating action of the refractory metallic oxides (alumina, thoria, tungsten oxide, &c.), and laid the foundation of another general reaction in which the alcohols are converted into unsaturated hydrocarbons. Conducted in the presence of ammonia, hydrogen sulphide or organic acids, these dehydrations lead respectively to organic amines, thiols, or esters. Bearing in mind the author's brilliant achievements in this field, his views on the mechanism of catalysis are of special interest. Whether occurring in homogeneous or heterogeneous systems, catalytic change is regarded as being due to the successive

formation and destruction of unstable intermediate compounds, the author asserting that this theory, in spite of certain imperfections, has been the guiding beacon in all his researches on catalysis.

G. T. M.

MATHEMATICS: PURE AND APPLIED.

(1) *Vectorial Mechanics.* By Dr. L. Silberstein. Pp. viii+197. (London: Macmillan and Co., Ltd., 1913.) Price 7s. 6d. net.

(2) *An Introduction to the Mathematical Theory of Attraction.* By Dr. F. A. Tarleton. Vol. ii. Pp. xi+207. (London: Longmans, Green and Co., 1913.) Price 6s.

(3) *A First Course in Projective Geometry.* By E. Howard Smart. Pp. xxiii+273. (London: Macmillan and Co., Ltd., 1913.) Price 7s. 6d.

(1) DR. SILBERSTEIN'S "Vectorial Mechanics" is an able exposition of the power of vector analysis in attacking certain types of physical problems. Heaviside's modification of Hamilton's original vector and scalar notations is adopted throughout. So far as the simpler applications of vector analysis go, the question of notation is apparently of little consequence. Almost every vector analyst who writes a book on the subject has his own pet notation; and there is a tendency for these authors to fail to recognise that their best creations are usually Hamilton's originals disguised. Even Dr. Silberstein, who knows and works quaternions, ascribes to Heaviside a formula given long ago by Hamilton, assigns to Clifford (1878) a problem which is completely solved in the first edition (1867) of Tait's "Quaternions," and refers to Henrici and Turner as authorities in connection with a simple geometrical problem given in Kelland and Tait's "Introduction to Quaternions." One might with as much historic truth ascribe the proposition Euclid i. 47 to the first English examiner who set it in an examination paper. Indeed, the historic references throughout the book are not all that might be desired. For example, it is incorrect to speak of Willard Gibbs as the one to whom, after Hamilton, the discovery of the fundamental properties of the linear vector function is due. What of Tait's powerful paper of 1868 on the rotation of a rigid body about a fixed point? It positively bristles with new-found properties and applications of the linear vector function. Dr. Silberstein's own chapter v. is simply a reproduction of part of this memoir. Then in the second edition (1873) of his treatise on "Quaternions," Tait for the first time develops the application of the linear vector function to strains; and in the last chapter of Kelland and Tait's "Introduction to Quaternions" (1873) presents the theory in a different form. Willard Gibbs's "Vector Analysis" (not published) was printed for the use of his students in 1881 and 1884. Apart from new names and a new and extremely interesting presentation, it is doubtful if Gibbs gave in that pamphlet any important property of the linear vector function which was not to be found in the pages of either Hamilton or Tait.

Then as regards the differential operator ∇ it was unquestionably Tait who, first in his paper on Green's and allied theorems (1870), and afterwards in his treatise on quaternions (second and third editions), developed it and showed forth its power. Willard Gibbs got it partly from Tait's "Quaternions" and partly from Maxwell's "Electricity and Magnetism"; and Maxwell got it directly from Tait. Yet while giving great credit to Gibbs and Heaviside, Dr. Silberstein does not mention Tait's name once. The manner in which Dr. Silberstein leads up to Stokes's "Theorem" is not convincing, that is, if the explanation is meant to be a proof. Phrases like "we may conclude" and "we may consider" are scarcely satisfactory in establishing a far-reaching mathematical transformation. Moreover, no attempt is made to establish the useful vector extensions of the theorems of Gauss and Stokes. It is, indeed, in these integral theorems involving the ∇ that, as compared with the quaternion vector analysis, the artificiality of other vector analyses mainly appears. The transformations lack flexibility. The reason for this is that outside the quaternion vector analysis the reciprocal of a vector is tabu, and the associative law in products is despised.

Apart from the necessary imperfections of a non-associative vector algebra, Dr. Silberstein's book contains many good things. In his treatment of the rotation of a solid body and of strain there is not so much of novelty, except when in the latter case he considers discontinuous motions. In the chapter on hydrodynamics, however, there are certain interesting developments which demonstrate the directness and value of vector methods. On p. 143 the long-winded semi-Cartesian transformation is needlessly laborious; for at once in quaternion notation:

$$S\sigma\nabla . \sigma = V\sigma V\nabla\sigma + \nabla_1 S\sigma_1\sigma = V\sigma V\nabla\sigma + \tfrac{1}{2}\nabla\sigma^2,$$

where σ is the fluid velocity.

(2) After a lapse of fourteen years Prof. Tarleton has brought out the second volume of his "Introduction to the Mathematical Theory of Attraction," the first volume of which was reviewed in NATURE for April 29, 1899. The chapters are numbered consecutively with the chapters of the first volume. An elegant discussion of spherical and ellipsoidal harmonics occupies chapter viii. In chapter ix. the author develops on familiar

lines the more elementary theory of magnetism, permanent and induced, with a brief sketch of the general theory of terrestrial magnetism. Chapters x., xi., xii. take up respectively electric currents, dielectrics, and the electromagnetic theory of light. The exposition is clear throughout, and well adapted to a student reading the subject for the first time. At the same time it will probably be felt by many that the book would have appealed to a wider audience if the spherical harmonic methods mathematically developed had been applied to definite problems in electrical or magnetic distributions. The author, however, is quite consistent in this neglect of practical applications; for although chapter xii. ends with the statement that the ratio of the electromagnetic to the electrostatic unit of electric charge is approximately 3×10^{10}, it is nowhere stated that this is the numerical value of the velocity of light.

(3) Mr. E. H. Smart's "First Course in Projective Geometry" is both well planned and well written. With the exception of a brief introduction to the method of projection in space, the first six chapters are devoted to the plane geometry of triangles, quadrilaterals, and circles, in which the principles of correspondence and duality, harmonic ranges, inversion, similitude, poles and polars, are developed in a systematic manner. In chapter vii. further theorems and problems on projection are given, and these suffice for what the author regards as the main purpose of his book, namely, a logical, coherent discussion of the geometry of the conic sections. In the later chapters the principle of duality is freely introduced, and the book finishes with typical examples of reciprocation. Most of the chapters contain brief historic notes which cannot fail to interest the student.

OUR BOOKSHELF.

Materials and Methods in High School Agriculture. By Prof. W. G. Hummel and Bertha R. Hummel. Pp. xi + 385 + plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 5*s*. 6*d*. net.

IN discussing the scope of their work the authors begin with a definition of the object of agricultural work in elementary schools and also in the universities. They then find that the position of agriculture in high schools lies intermediately between these two positions. The purposes of agricultural work in the elementary schools are stated to be the opening of the minds of children to the common phenomena of nature, the inculcation of habits of observation, and the setting up of higher ideals in country life, but not to make farmers or farm labourers. In the colleges, on the other hand, the work lies in the investigation of the more fundamental problems of agricultural science and practice. The high schools should teach practical agriculture, educating their students for the actual business of the farmer; the course should not, however, be narrowly vocational, but should be cultural and disciplinary as well, and should prepare the students to be broad-minded and intelligent, progressive citizens.

Considerable stress is laid upon the necessity for finding suitable teachers; the teacher must not only possess agricultural knowledge, but be able to impart it to others. Neither the purely scientific man nor the purely practical man has turned out a success. The former fails because he lacks the proper point of view, and knows nothing of practical farming conditions; the latter fails because he does not know the first principles of the subject, and is unacquainted with the scientific basis of agriculture.

The book is full of interest, and can be cordially recommended to all who are engaged in the work of agricultural education at schools, farm institutes, and colleges.

The Deciding Voice of the Monuments in Biblical Criticism. By Dr. M. G. Kyle. Pp. xvii + 320. (London: S.P.C.K., 1912.) Price 4*s*. net.

THE author of this work would probably not resent the suggestion that he writes as an advocate or partisan, rather than as an impartial assessor, in a long-drawn-out dispute. The field he surveys is a well-trodden one—the relation between the Bible and the monuments—and his attitude is that of the most traditional and conservative of writers on this subject. His thesis throughout is to the effect that modern archæological study has entirely disposed of the claims advanced on behalf of the textual criticism of the Old Testament. In his view the whole work of the critical school is discredited, and the labours of Hebrew scholars for more than a century past, so far from resulting in a truer and more accurate appreciation of the Hebrew text, have been worse than useless. His position may be indicated by the fact that he maintains the unity of the book of Isaiah, and holds that the book of Daniel embodies the prophecies of a historic person of that name who prophesied in Babylon during the exile, and was written by him or by one of his contemporaries. It does not lie within the scope of this journal to follow the author along his controversial path. But with the best will in the world to be convinced, we cannot help feeling that he is engaged in that rather pathetic process of trying to put back the hands of the clock. We feel sure he would have been far more convincing had he proved himself a less thorough-going partisan.

Astronomy. By Ellison Hawks. Pp. 120. (Manchester: Milner and Co., n.d.) Price 1*s*. net.

IN these 120 pages the author presents the subject of astronomy in such a way that the beginner will wish to carry his reading further. The style is elementary, clear, and chatty, and the reader is led on from one subject to another in a natural sequence. He is first introduced to the astronomy of the ancients, and then of to-day. The historical account of the telescope is followed by the practical forms of to-day, leading up to the famous observations of the present time. Then follow concise statements about the sun, moon, planets, comets, stars, coloured and multiple, clusters and nebulæ, &c., all of which are sufficient to give the reader an interest in the subject and a wish to know more about them. Many practical hints and much good advice are given which will be serviceable to those who are making use of small telescopes. Numerous well-chosen illustrations, many of which are from the pencil of the author, accompany the text. A glossary of astronomical terms, a brief bibliography of the more elementary astronomical books and an index bring this practical little book to a conclusion.

The Petrology of the Igneous Rocks. A Summary of the modern Theories of Petrogenesis, a Description of the Rock-forming Minerals, and a Synopsis of the chief Types of the Igneous Rocks and their Distribution as illustrated by the British Isles. By Dr. F. H. Hatch. Seventh edition, revised. Pp. xxiv+454. (London: George Allen and Co., Ltd., 1914.) Price 7s. 6d. net.

ATTENTION has been directed in these columns to this now well-known text-book on two previous occasions. On May 14, 1891 (vol. xliv., p. 25), the first edition was reviewed at length, and on May 20, 1909 (vol. lxxx., p. 337), the fifth edition was noticed. It will be sufficient to say of the present edition that it has undergone considerable revision and that new chapters on the pyroclastic rocks and the metamorphic derivatives of the igneous rocks have been added, together with numerous new illustrations.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Active Nitrogen.

A PAPER appears in the *Berichte* (vol. xxxvi., 17, p. 4095, 1914), by E. Tiede and Domcke, in which it is again maintained that the glow characteristic of active nitrogen is not seen in the absence of oxygen. In the experiment chiefly relied on, the authors prepare nitrogen in an exhausted apparatus, by heating barium or potassium azide; and they lead it through a cooled vessel straight into the discharge tube, also exhausted. They state that after careful washing out with nitrogen, no afterglow appears. We do not know how to account for their conclusion, but we can only state that in our hands the experiment gives exactly the opposite result. We used potassium azide, and after most thoroughly heating the glass and the electrodes and washing out the vessel repeatedly with nitrogen, the glow remained absolutely undiminished in intensity.

We have also tried a new experiment. Some of the liquid alloy of sodium and potassium was placed in a discharge bulb, which was charged with rarefied nitrogen. The surface of the alloy is quite bright, and the nitrogen has been standing over it for three weeks, but the afterglow is as good or better than ever. Fuller details of these experiments will be published later.

Finally, even if what Tiede and Domcke say were true (which we entirely deny), we do not see that it would alter the fact that a gas has been obtained by one of us capable of reacting in the cold with, *e.g.* hydrocarbons to form hydrocyanic acid. If this is not active nitrogen, what is it?

H. B. BAKER.
R. J. STRUTT.

Imperial College of Science, February 10.

Weather Forecasting.

MR. DEELEY'S plea (NATURE, January 29) for increased aid to meteorology certainly deserves serious consideration. Under the present condition of affairs it is not possible to issue forecasts for more than a day or two in advance with much hope of success, but there is no reason why this should continue indefinitely. Seasonal forecasts would be of immense importance to agriculture, more so, indeed, than forecasts for the following week, because, were the character of an ensuing summer known, it would be nearly always possible to plant crops that would thrive under the expected conditions. It is quite possible that if we had a sufficiency of good charts covering the greater part of the earth, seasonal forecast might be made empirically, just as daily forecasts now are, and were they as successful as the present daily forecasts, the occasions on which a fairly good harvest could not be secured would be few, for it is seldom that the weather is not favourable for some one or two crops.

The key to the whole situation lies in being able to foretell the distribution of pressure. Being given a chart with the isobars on it, it is possible to fill in a great deal more with fair certainty.

But at present we are hopelessly in the dark as to the reasons of cyclones and anticyclones, why they form and why they move. The investigation of the upper air has led to this, that all our old theories about cyclones and anticyclones must go to the scrap-heap. It has been usual, and is still for that matter, to explain a high or low barometer by saying that the air over them is respectively cold or hot. The exact opposite is the fact. If the barometer in Europe at a certain place is very low it is a practical certainty that the greater part of the mass of air lying over that place will be very much colder, and therefore heavier, than usual. Facts of this sort have to be explained before we can hope to advance much farther.

But there is very good hope for the future. If the upper air investigation has entirely altered our ideas as to the cause of pressure changes, it has also shown that the conditions prevailing above are far more simple than they are below. If an isobaric chart for a height of 9 km. for Europe could be drawn for a given date, that chart would enable us to fill in with fair accuracy the temperatures, and therefore also the pressures, for the space covered between the heights of 1 km. and 20 km. Higher than 20 km. the observations do not go, and below 1 km. the conditions are exceedingly complex, but within the limits given the temperatures do not differ very far from linear functions of the pressure at 9 km.

It seems, therefore, as though the surface changes are a sort of by-product of the changes occurring above, but the outstanding puzzle is what produces and maintains the changes of pressure above.

Increased State-aid would help to solve this problem, for daily observations at one station up to an average of about 15 km. could be carried on in England at a cost of about 1000*l.* per annum, and a daily record of the changes occurring above would be of the greatest value. Increased money aid is also desirable to enable England to join in a general scheme for the production of charts covering the whole known surface of the globe. It is not, of course, certain that any immediate improvement in the forecasts would ensue, but increased knowledge would inevitably in the long run take a practical form, just as it has in every other branch of science.

Increased aid in another form is also much to be desired. The number of observations that have been tabulated and published is immense, but comparatively little working up has been done. The physical processes of the atmosphere present many fascinating problems; to go no further, we may instance the fall of temperature with height, and the abrupt cessation of that fall at about 11 km.; the facts are fairly well known, and the mechanical and thermodynamical principles that should explain them are known. There is plenty of work for many workers, and there are probably plenty of men well equipped with the requisite knowledge of mathematics and physics looking for some useful field of work. I would therefore commend to them the problem of the general and local circulation of the atmosphere.

W. H. DINES.

Watlington, Oxon., January 30.

Dr. Bastian's Evidence for Spontaneous Generation.

WE notice, in a communication that appeared in a recent issue of NATURE (January 22, p. 579), that Dr. Bastian is apparently under the impression that we accept his own interpretation of the "organisms" which have appeared in his sealed and sterilised tubes, viz. that they really are *living organisms*.

This does not represent our position. Dr. Bastian has kindly afforded us an opportunity of examining the contents of his tubes, which were opened in our presence, and although the resemblance between the "organisms" in question to living Torulæ, &c., was sufficiently striking, it did not seem to us to be proved that the similarity went beyond mere resemblance. We were not, and still are not, convinced of the living nature of these "organisms" at all, still less that they are living organisms spontaneously generated.

One of our colleagues, Mr. Paine, is engaged in repeating Dr. Bastian's experiments with the view of solving the problem as to what may be the actual nature of the appearances in question.

J. B. FARMER.
V. H. BLACKMAN.

Imperial College of Science and Technology,
January 30.

A Possible Cause of Explosions in Coal Mines.

IF a cloud of dry dust is suddenly raised by a current of air and projected against an insulated conductor, the latter becomes charged with electricity to such a potential that sparks several centimetres in length may be obtained. It does not matter much—save in respect to the sign of the charge—what the nature of the dust is, for sand, coal dust, flour, or iron filings all give rise to strong charges. Sand gives a positive charge and coal dust a negative one. It therefore appeared possible that a cloud of dust raised by a sudden fall, or other means, in a mine might charge up an insulated conductor to such an extent that a spark could pass to an earthed conductor near it, and thus fire an explosive mixture of gases if this was present.

Some observations recently taken in the Ludlow Pit at Radstock have more or less confirmed this theory. In conveying the coal from the working seam to the shaft a considerable amount of dust is raised, and, walking behind the train of wagons, any electrification due to the dust was easily indicated by a Wulf electrometer furnished with a radium-tipped wire to act as a collector. With only a moderate amount of dust the electrometer indicated a potential of more than 280 volts, and a hollow insulated conductor held in the dust-cloud was also strongly charged. Sparks, however, could not be obtained in the mine, but on making experiments in the laboratory with coal dust from the mine, it was easy to charge up a metal tube to such a potential that sparks up to 1 cm. in length were obtained from it by blowing through the tube a stream of dust.

The dust actually present in the mine was, save close up to the working seams, never pure coal. In order to minimise the risk of dust explosions, large quantities of fine flue dust from the boilers were scattered in all the workings, so as to cover the coal dust, and this flue dust gave a charge of *opposite* sign to that upon the coal. When tested in the laboratory the mixture would *not charge* a conductor to a sparking potential, whilst pure coal dust, and more particularly the flue dust, gave very strong charges. If, then, such a combination should occur as that of a sudden cloud of coal, or perhaps other dust, an insulated conductor, an earth-connected conductor near it, and an explosive mixture of gases, it is not inconceivable that an explosion might follow. I make the suggestion quite tentatively.

W. A. DOUGLAS RUDGE.

Cambridge, January 28.

The Eugenics Education Society.

IN NATURE of January 29, Prof. Pearson complains that the sentence, "but even he (Sir Francis Galton) in the *last few months* of his life saw that the popular movement he had started was likely to outgrow its knowledge, and feared that more evil than good might result from it," which appeared in his letter to *The Times* of October 15, has been misquoted in the January number of *The Eugenics Review*, the words *last few months* having been altered to *last years*. He then goes on to say: "The controversial methods which can change 'last months' into 'last years,' and then cite letters of 1909 are characteristic of that looseness of procedure which must eventually be fatal to any popular movement run by this society." As a member of the editorial committee of *The Eugenics Review*, I passed the final proofs for the press, and so share the responsibility for the mistake with Major Leonard Darwin, who actually wrote the note in question. I do not quite understand what Prof. Pearson means by "looseness of procedure." If he merely means "making mistakes," then, although I have no wish to minimise the evils and dangers of so doing, I cannot agree with him that it "must be fatal to any popular movement run by the society." I hope I shall not be accused of promulgating a dangerously original doctrine if I say that it is human to err. Indeed, Prof. Pearson has on occasion been human enough to do so himself. Yet many human institutions, including those connected with Prof. Pearson, continue to flourish.

It is possible, however, that his words contain a more serious charge, namely, that of deliberately misquoting him in order to contradict him. I do not suppose that Prof. Pearson would actually accuse Major Darwin and myself of such dishonesty, but he has not guarded his words against the possibility of this interpretation being put on them, and so I meet the charge—in the only way possible—by a flat denial.

It is interesting to inquire how the mistake under discussion could have arisen. It seems probable that the words "last few months" conveyed the idea of some indeterminate period of time, and that this idea and not the actual words were held in the memory, afterwards to be retranslated into words as "last years." This would probably not have occurred if Prof. Pearson had himself been a little more precise in the first instance. The interview which he refers to during which Sir Francis Galton expressed doubts concerning the policy of the Eugenics Education Society took place about three weeks before Galton's death. Is three weeks the precise period which Prof. Pearson describes as a few months? The last letter quoted in *The Eugenics Review* in answer to Prof. Pearson's original letter was written, not in 1909, but in October, 1910, about three months before Galton's death.

Finally, when Prof. Pearson wrote, "I have no other effective means except through the courtesy of your columns to correct a wholly erroneous statement, which the editor of that society's journal has put into my mouth," had not he already received a letter from Major Darwin apologising for the mistake, and assuring him that it would be corrected in the next number of *The Eugenics Review*?

EDGAR SCHUSTER.

110 Banbury Road, Oxford, January 30.

Origin of Argentine Wild Horses.

ANENT the recent discussion as to the origin of the wild (or feral) horses of the Argentine Republic, there is one line of evidence to which I venture to direct attention. That is the question of infertility.

Assuming, as I suppose most reasonable people do, that the South American horses were derived originally from the north—whether in the northern part of North America or in north-eastern Asia is immaterial—and that the South African horses are similarly derived, it would seem that the Argentine species would be at least as remote geographically from the wild ancestors of the domestic horse as are the modern zebras and asses, and could not be any more nearly related genetically. The species native to the Argentine, if they continued to exist down to modern times, would have evolved in complete isolation from any northern species since the early Pleistocene at least, and probably longer as regards any Old World species. Now the infertility of crosses between zebras or asses and domestic horses is based upon a separation that does not appear to date earlier than the late Pliocene. Beyond that they must be derived from a common stock. The autochthonic Argentine horses were therefore not any more nearly related to *Equus caballus* than are the zebra or the ass. They should therefore be equally infertile when crossed with the domestic stock. (The degree of infertility of distinct species varies in different families of mammals; but the known facts regarding the horse, asses, and zebras afford a measure of its degree in this family.) So far as I know there is no record of infertility in such crosses, and since, as I am informed, the wild horses are caught and domesticated on the pampas just as they were in the western United States, any such infertility could scarcely escape notice. This would seem to me to be a decisive argument against the theory that the existing wild horses of South America are descended either wholly or partly from any surviving native stocks. The argument would apply with less force to the wild horses of the western United States and Mexico, yet even with these it would appear to be a strong point. But the geologic evidence against the survival to modern times of any native horses in North America is very nearly conclusive in itself.

Even if we admit that some of the native horses may have survived in the Argentine until the time of the Spanish settlement—and I think that the evidence for that contention is strong, and that it is quite in conformity with some other features in the faunal history of South America—the native stock would presumably be no more able to interbreed with domesticated or feral stock of *Equus caballus* than could the quagga in South Africa. It would remain separate and immiscible until exterminated. No strain of it could survive in the modern feral horses.

W. D. MATTHEW.

American Museum of Natural History, New York, January 15.

Specific Heats and the Periodic Law.

AT his last Friday evening lecture at the Royal Institution Sir James Dewar announced his somewhat startling discovery that at temperatures of about 20° absolute the specific heats of the elements are periodic functions of the atomic weights, and are therefore not in accordance with Dulong and Petit's law (established at ordinary and higher temperatures). May I venture to point out that a simple consideration of the difference of conditions in the experiments of Sir James from those of Dulong and Petit may ultimately harmonise the two sets of results?

From Guldberg and Wage's "mass law" it follows that the velocity increases with the mass (atomic weight), but this increase of velocity takes place at higher temperatures at a very much greater rate, with the result that at higher temperatures the atomic mass becomes relatively less important, *i.e.* the special atomic properties will be less emphasised. The velocity factor becoming so predominant, a proportionately smaller additional increase of (heat) energy will be required to raise the mass to a higher temperature, *i.e.* the specific heat will be inversely proportional to the mass (Dulong and Petit's law). At very low temperatures—say at about 20° absolute—when the velocity is very small—almost negligible—the *mass* of the atom is the predominant factor, and hence we find a periodic function of the atomic weight as the expression of the specific heat as well as of the other (physical and chemical) properties. The above suggestion might be tested by experiments to find a temperature at which neither the Dulong and Petit nor the Dewar law would be strictly obeyed.

H. LEWKOWITSCH.

22 Meadway, Hampstead Garden Suburb, N.W., January 31.

The End-product of Thorium.

IN continuation of our letter published in NATURE of February 5, containing a suggestion as to the nature of the end-product of thorium, we would point out that, of course, our view involves atomic weights for the various disintegration products of thorium higher than is ordinarily assigned to them, and that therefore the determination of the atomic weight of any one of them would afford a test of the truth of the hypothesis.

J. JOLY.
J. R. COTTER.

Iveagh Geological Laboratory, Trinity College, Dublin, February 7.

FIORDS AND OTHER INLETS OF THE SEA.[1]

LIKE an experienced teacher, Prof. Gregory begins his book on "The Nature and Origin of Fiords" by a definition of its subject. Fiord is a Scandinavian word, and fiords are common on a large part of the coast of Norway, but the term is often used vaguely, and sometimes, as we shall see, with unjustifiable restrictions. With him it denotes an inlet of the sea, bounded by lofty and steep opposing walls; piercing far into the land, and consisting of long straight reaches, which turn and receive their tributaries at sharp angles. Thus, though a fiord is a sea-drowned valley, not all such valleys can be called fiords. It has been carved, as the definition suggests, in a plateau more or less elevated, which consists of hard rocks, and it is named a fiard when this plateau is low, the difference between the two being obviously varietal rather than specific, and a comparatively slight elevation, on such a coast as that of Norway, might show the one to end in the other. It remains narrow to its seaward end, thus differing from an ordinary estuary, which widens in that direction, so that waves may have helped in forming it, while they have done little for the fiord; and when one of the former has an irregular outline, and is bordered by bold rugged hills, it is designated a ria, from a Spanish name. Fiords are frequent in the northern and southern portions of the globe, and practically absent from the more tropical regions; they also often bear marked signs of glaciation. That, however, does not prove them to have been excavated by ice, or justify refusing to give the name fiord to a submerged valley with the other qualifications, for any such limitation is importing a hypothesis into a definition. This geographical distribution, however, is a fact, and Prof. Gregory attributes it to terrestrial conditions, which make oscillations in level more frequent in the higher than in the lower latitudes.

From this preliminary discussion he proceeds to describe concisely the fiords in the several parts of the globe, in order to ascertain, by inductive study of their phenomena, by what agencies they may have been formed. Beginning with those of Norway, the home of the name, he points out the more important features in each, its relation to the neighbouring district, its outline and dimensions, with details, whenever obtainable, of its subaqueous contour. The Sogne fiord in Norway, one of the most accessible to English visitors, exhibits the characteristic features of such an inlet, especially in its upper branches, not less distinctively than that grand example, Milford Sound, in New Zealand (Fig. 1). The sides, to summarise Prof. Gregory's description, are high and steep, not broken by deep gullies, so that the streams rising on the uplands frequently descend as waterfalls over the walls instead of as cataracts hidden in deep gullies. We may therefore conclude that these cascades are comparatively modern—more modern, for instance, than in the Alps, where the other habit is the more common. Those sidewalls also are often subparallel, so that the fiords for considerable distances are uniform in width, their valleys also taking a straight course. The most typical Norway fiords are surprisingly deep, the maximum in the Sogne fiord being almost 4000 ft., and the walls descend for a long way beneath the surface of the water with as steep a slope as they have for some 2000 ft. above it. Thus a cross-section of their floors is trough-like, but the longitudinal one is a concave curve. In some cases the fiord bed rises and falls more than once in this direction, as in some Alpine and Scotch lakes, but in most cases, though not in all, the fiord has an outer (submerged) rim, sometimes narrow, sometimes comparatively wide, which prevents a free influx of the deeper ocean water. This, though it may sometimes consist of moraine deposited by a retreating glacier, or of ordinary detritus, like the bar at the mouth of an estuary, must often be, as Prof. Gregory explains, a true rock barrier. This last characteristic, together with their ice-worn rocks, the truncation of spurs from the mountain on either side, and their geographical distribution, have caused some geologists not only to attribute fiords to glacier erosion, but also to refuse the name to any similar submerged valley which could not have been formed in this way.

FIG. 1.—Map of Milford Sound, New Zealand. From "The Nature and Origin of Fiords."

[1] "The Nature and Origin of Fiords." By Prof. J. W. Gregory, F.R.S. Pp. xvi+542+viii plates. (London: John Murray, 1913.) Price 16s. net.

But besides the general objection to this limitation, which has already been mentioned, the Dalmatian coast can show fiords as characteristic as those of Norway, though glaciers can never have been more than unimportant features on even the highest of the Dinaric Alps (Fig. 2). A glacier which continues to descend a main valley after those in the lateral glens have shrunk and ceased to be tributaries, may have converted the latter into hanging valleys; its ice-stream may have replaced the rugged ends of spurs by smooth facets, but a river also, in similar circumstances, can produce the one and the other, and, in many cases, as Prof. Gregory shows, it can be proved that the valleys occupied by fiords are pre-glacial.

But, as he proceeds to point out, the larger features of fiords—the straight channels terminated by a sharp twist, the high angles made by tributary valleys, indicate a close connection with the greater earth movements which have determined the main physical features of the region. A set of diagrams brings out clearly the frequent relation between the fiords, the lakes, the mountain ranges, and the shore lines in different regions, showing that the first and second very frequently follow the course of important faults. This seems indubitable, but we must remember that the work of the latter, though indispensable as a preliminary, has had an indirect, rather than a direct, effect in producing the present scenery. In regard to this a too frequent use of the term "rift valleys" may sometimes mislead: for a rift means a lateral rather than a vertical displacement, and should only be applied, as I pointed out in the *Geological Magazine* for 1905, where the surface is comparatively "raw"; for the "leading lines" in such an example as the Jordan valley can only be discovered by close study of the geology. In such cases the older name, trough-fault valley, seems preferable. Apart, however, from this question of nomenclature, Prof. Gregory supports his view, both against ice-excavation and in favour of earth movements, as the primary cause of fiords, with arguments which will be very difficult to overthrow. But we must conclude, and do this by expressing our hearty thanks to him for this admirable history of fiords and other forms of inlets of the sea. It will be a great boon to students, for it is a veritable encyclopædia, full of important facts, the collection of which must have entailed long and patient labour, because they are scattered about many publications in sundry languages, and often not readily accessible.

FIG. 2.—Cattaro Bay, the inner Branch of the Cattaro Fiord. The spurs on the fault-block on the left side of the view show triangular facets due to faulting. The precipitous slope above Cattaro, on the right margin of the view, is a fault-scarp. From "The Nature and Origin of Fiords.

T. G. BONNEY.

EDUCATIONAL LEGISLATION IN NEW SOUTH WALES.

THE economic, social, and educational problems which present themselves for solution in the free atmosphere of our more prosperous colonies, unhampered by tradition and conventions, and with their fresher outlook, often present features in the attempt to solve them well worthy the attention and possibly the emulation of those engaged upon similar questions at home.

We are on the eve of great educational changes, if we are to trust the somewhat vague utterances of the Lord Chancellor and of the Minister for

Education; and amongst them there are few reforms more urgent than the adoption of measures which will secure to the nation the fullest advantage of the best brains of its children.

The measures recently enacted by the legislature of New South Wales, as explained in a paper by Prof. H. S. Carslaw, reprinted from the *University Review* of Sydney, of July 13, 1913, which have for their object the opening of a clear road to the poorest scholar of talent and ability in the State from the elementary school to the university, deserve the closest attention of all who are interested in the highest welfare of the mother country.

The Act is an attempt to bring educational opportunity within reach of all those who, by ability, attainments and character, without distinction of class, can worthily take advantage of it.

It seeks to coordinate effectively the secondary schools, both public and private, with the university, so "that under it the best pupils of the schools will have unrestricted access to the highest available education," and to complete the educational system built up in the State during recent years so as to form "a progressive and continuous whole," from the primary through the secondary and technical schools to the university. In the words of Mr. Carmichael, the Minister of Education, "We want to make the university the final effort in the educational scheme as laid down by the Government; to exclude nobody, but to include everybody who has brains and application.

To this end a scheme of university exhibitions has been arranged allotting one to every five hundred of the population who are between the ages of seventeen and twenty, and exempting the holders from the payment of matriculation, tuition, and degree fees to the university.

There will thus be, on the basis of the present population of New South Wales, about 200 university exhibitions to award in 1914, and taking the average university course as four years, there would accordingly be, when the scheme is in full working order, 800 students enjoying the advantages of the Act in any one year.

But the cardinal feature of the scheme is to be found in the methods of award. All attempts at determining the merits of the candidates solely by an external examination, such as that of matriculation, are abandoned. Instead thereof, a system of leaving certificates is established, for which pupils in the duly registered high schools, whether State or private, which offer at least a four-year course beyond the primary stage approved by a specially constituted board upon which the university is largely represented, are eligible, provided they have passed through the complete four-year course to the satisfaction of the principal alike in respect of attainment, conduct, and personal character.

The pupils are then required to pass an examination in at least four subjects of their school course to the satisfaction of a board of examiners comprised of four officers of the department of public instruction and four professors or teachers of the university nominated by the senate.

The leaving certificate is thus awarded (*a*) upon the result of the four years' work in the high school; (*b*) upon the successful passing of an examination in certain subjects of the school course, and those pupils who take the highest places in the examination list are awarded the university exhibitions.

To meet, however, the cases of persons who have been privately educated or who have pursued their studies in later years and are thereby precluded from obtaining leaving certificates, a number of university exhibitions not exceeding five per cent. are offered annually to such persons who pass certain prescribed examinations. Provision is also made for students in evening tutorial classes.

Merely to exempt pupils from fees would not, however, remove the obstacles in the path of deserving but poor students, and so arrangements are made to meet such cases by bursaries in aid of their maintenance during the whole period of their studentship.

As will be inferred from the foregoing statement, the proposals are really a long step in the direction of making the university free to all competent students, and to meet this the Government is prepared largely to increase the State endowment, so that the university shall not be crippled in its resources or development.

It is part of a policy, in the words of Lord Haldane, to "secure for our national endeavours the help of our best brains," and that is its justification, and the reason why the experiment in New South Wales is deserving of the most serious consideration at the hands of our educational administrators at home.

There are those who doubt "whether the true educational ideal for an industrial community is that of an open road from the elementary school to the university," but if the university embraces, as it should, not only provision for the highest learning in all branches of knowledge, but also, as it should, training in their application, there need be little fear that the offer of "an open road" will not redound to the lasting good of the nation.

J. H. REYNOLDS.

DR. ALBERT GÜNTHER, F.R.S.

ALBERT CHARLES LUDWIG GOTTHILF GÜNTHER, whose death on Feburay 1 we announced with regret last week, was descended from a family which settled in and about Möhringen on the Filder Plateau at the beginning of the fifteenth century, his father, the Estates Bursar of Möhringen, having taken up his residence in Esslingen, where Albert was born on October 3, 1830. After attendance at the Stuttgart Gymnasium, his family destined him for the Lutheran Church, and with that view he was trained at the Theological College of Tübingen, where, as a student connected by descent with the Duke of Wurtemberg, he had free education. But science and medicine had greater attractions for the young naturalist, especially under such a teacher as Johannes

Müller, so that, after graduating as M.A. and Ph.D., and studying at Berlin and Bonn, he by and by became M.D. of Tübingen. Moreover, he, as a citizen of Prussia, did his share of military duties, and acquired the skill in the use of fire-arms that made him so good a sportsman in field and cover. He also published an account of the "Fishes of the Neckar," and a "Handbook of Medical Zoology"—visiting London thereafter in 1856.

Dr. Günther's writings had attracted the attention of Sir Richard Owen, and when they met in the British Museum, a friendship sprang up between them, the result of which was that he was ere long placed in charge of the fishes, amphibia, and reptiles in the museum. Few men could more conspicuously have justified the choice thus made, both by his contributions to systematic zoology and his capacity for administration. Thus settled at his favourite pursuits and surrounded by congenial companions, there issued from his pen a great landmark in zoology, viz. his ten volumes on Colubrine snakes, *Batrachia salientia,* and fishes; and, in addition, the Ray Society issued his fine volume on the "Reptiles of British India." His and Sir Lambert Playfair's beautifully illustrated work on the fishes of Zanzibar next appeared. With a critical eye to artistic work he had enlisted the aid of that lithographer *facile princeps,* G. H. Ford, so that almost all his papers and works were illustrated by this skilful yet delicate artist till his death in the 'seventies. To the Royal, Linnean, and Zoological Societies he contributed a long list of important papers, both systematic and structural, such as his well-known memoirs on Ceratodus and Hatteria (Sphenodon).

But the foregoing give only a partial view of the results of Dr. Günther's well-directed energy, laborious research and unflagging zeal. His "Fische der Sudsee," "Gigantic Land Tortoises," his most useful "Introduction to the Study of Fishes," his massive volumes on the "shore," "deep-sea," and "pelagic" fishes of the "Challenger," and the "Report on the Batrachia of Central America," have further to be taken into account. It may be truly said that no predecessor in his office did more continuous or more valuable work as a systematist than he. Besides, Dr. Günther was the founder and first editor of the *Zoological Record,* now carried on by the Zoological Society; and for thirty years he was the chief editor of the *Annals of Natural History.*

Yet another side of his wonderful energy and tenacity of purpose has to be recorded. The routine work in the British Museum is no light burden even for the robust, but Dr. Günther's term of office embraced a critical period, viz., after he became Keeper of the Zoological Department. Whilst to Sir Richard Owen belongs the honour of the scheme for a national natural history museum, to Dr. Günther fell much of the work of designing the galleries and cases, and, more than all, of transferring the gigantic collections to their new home. The minute of the trustees attests how ably and how successfully he accomplished this difficult task. It is interesting that, even at this early period, Dr. Günther was in favour of metal cases, though these were not adopted—probably on the score of expense. His personal influence with naturalists, travellers, and owners of estates at home and abroad was of infinite importance throughout to the national collection. Further, he reorganised the duties of the trained attendants in the museum, and thus relieved the scientific staff, which was gradually increased from four to thirteen scientific men, whose names are those of authorities in their several departments. To Dr. Günther is also largely due (1) the formation of a general library—so valuable, especially to zoologists—and (2) the designing of a separate spirit-room for the safety of the vast collections in jars, as well as for that of the institution itself. He retired from the office of keeper in 1895.

Considered from the point of view of his study, Dr. Günther was the foremost man of the day in his department; but he was also an accomplished field naturalist, equally at home in park and covert, or by lake and river. In his earlier days he was remarkably agile and hardy, and used to say he gained as much knowledge of natural history in the field as in the closet. Nor was he less keen on board a boat or yacht at sea; indeed, he more than once was the only effective zoologist on deck, as, for instance, when the late distinguished Prof. Kölliker enlisted him on a dredging expedition off the southern coast. His tanks for the preservation of rare or interesting forms for the British Museum were always in evidence on such occasions, and he spared neither labour nor care in the pursuit of his fishes and other forms. His home, moreover, reflected the dominant tastes of the man. Tree-frogs, chameleons, which fought for the best perch near the fire with tiny parrots, bird-cages indoors, and aviaries outside, the wonderful black and white gracle, the legacy of the late Lord Lilford, and other pets, made every visit memorable after his retirement from the museum; and the same may be said of the trees, shrubs, and flowers in his garden.

Thus his busy life passed to his eighty-fourth year when grave abdominal symptoms necessitated an operation, which, at first apparently successful, terminated his distinguished career. He was buried in Richmond cemetery, in the midst of a circle of sympathetic scientific friends.

Dr. Günther was the recipient of many honours from learned societies in Europe and America, whilst at home he had filled the offices of vice-president of the Royal Society, president of the Biological Section of the British Association, and president of the Linnean Society. He received the royal medal of the Royal Society, and the gold medal of the Linnean Society, as well as the medal of the Avicultural Society.

He was twice married—his first wife, Roberta McIntosh, many of whose exquisite coloured drawings have been published by the Ray Society, dying in 1869 on the birth of her son, Robert, now the zoologist, geographer, and antiquarian of Magdalen College, Oxford; his second wife was Theodora Drake, of Fowey, a lineal descendant of a brother of Admiral Drake, who, with a son, survives him. Dr. Günther was one of the kindest parents, and spared neither time nor pains for the comfort, education, and happiness of his family, to whom, and to all who knew him intimately, he was endeared.

As a great systematic zoologist, as a naturalist who had early and independently worked out many of the problems of the distribution of animals, as a man of untiring energy and great powers of administration—these, and his solid work in the museum he loved so well, will ever be his best monument.

NOTES.

THE KING, accompanied by the Queen, opened the new session of Parliament on Tuesday, February 10. In his speech to the assembled Houses, he stated that among other measures to be presented would be one to give effect to the proposals, which were announced last session, for the development of a national system of education.

PROF. J. G. FRAZER has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public service."

WE announce with much regret the death on February 6, at sixty-five years of age, of Mr. H. B. Woodward, F.R.S., formerly assistant-director of H.M. Geological Survey.

ACCORDING to the *Revue Scientifique* the Russian Minister of Public Instruction has made a grant of 100,000 roubles (10,570*l.*) to the St. Petersburg Academy of Sciences to assist a search for radio-active minerals throughout the Russian Empire.

THE death, on January 12, is announced, at seventy-seven years of age, of Dr. C. M. Woodward, emeritus professor of mathematics and applied mechanics in Washington University, and past-president of the American Association for the Advancement of Science.

AT the annual general meeting of the Royal Astronomical Society, to be held to-morrow, February 13, the gold medal of the society will be presented to Prof. Max Wolf, director of the Heidelberg Observatory, for his work in celestial photography and spectroscopy. Prof. Wolf is expected to be present at the meeting.

DR. W. E. FARABEE, who is leading an expedition in Brazil on behalf of the University of Pennsylvania, has sent home word of the success of the first part of his journey. He had passed through the territory inhabited by the Macusi Indians, and had encountered several of the Carib tribes that were supposed to have disappeared, including the Wai Wai tribe. The ethnological study of these early inhabitants of the Carib-bean region is one of the main objects of the expedition.

SIR ERNEST SHACKLETON stated at the Royal Geographical Society on Monday that on his forthcoming Antarctic expedition he proposes to take four geologists, two meteorologists, and two biologists. His scientific staff will be distributed as follows:—Trans-Continental party, one geologist; western party towards Graham Land, one geologist and another man of science; eastern party to Enderby Land, one geologist; Weddell Sea base, one meteorologist and one biologist; on board the ship one biologist, and Captain Davis, hydrographer; supporting party from the Ross Sea side, one geologist. The various parties will be sure to bring back sufficient results to justify the purely scientific side of the expedition. The main object of the expedition is the crossing of the south polar continent from sea to sea; and the very nature of the journey will solve the question of a divided or a single continental mass.

CORRESPONDENTS of *The Times* report that four slight, though distinct, earthquake shocks were recorded on February 10 by the seismographs at Albany and Washington. The tremors extended from Brooklyn to Buffalo, through Connecticut and Pennsylvania, and north to the district along the St. Lawrence River. The seismograph at the Museum of Natural History in New York shows that the shocks began at 1h. 35m. p.m., and ended at 1h. 37m. 30s. Two pronounced earthquake shocks were registered by the seismograph at Toronto Observatory—one at 11.30 a.m. and the other at 1.29 p.m. The shocks were felt generally throughout the province. The entire St. Lawrence valley around Montreal was also affected.

As announced in *The Times* of January 30, Lord Tankerville has presented to the Zoological Society a young pair of the white cattle from his park at Chillingham, Northumberland. According to an article in the same journal of February 2, the animals were caught as yearlings by enticing them with food into a trap. Although the Chillingham and other white park cattle are often termed "wild," they are really descendants of domesticated breeds which have reverted to a semi-wild state.

INFORMATION has been received that through the generosity of Mrs. Rotch, the observatory at Blue Hill, near Boston, founded by the late Prof. Lawrence Rotch, for the study of the upper air, and partially endowed by his bequest of fifty thousand dollars, has been established for five years in connection with Harvard College. Mr. McAdie, formerly in charge of the Californian section of the United States Weather Bureau, has been appointed director of the observatory, and at the same time professor of dynamical meteorology in Harvard University. We also understand that provision is to be made in connection with the French department of war for continuing the aërological work carried on by the late M. Léon Teisserenc de Bort, at his observatory at Trappes.

WE learn from *The Times* that the Austrian Geographical Society has decided to honour the memory of Captain Scott by the posthumous award of the Hauer medal, the highest distinction the society has to offer. Another tribute to Captain Scott's memory is the erection, on the Col du Lautaret, a pass in the French Alps, at the suggestion of Dr. Charcot, of a rough stone cairn with a bronze tablet bearing the inscription:—"Captain R. F. Scott, of the English Navy, who, on his return from the South Pole, died bravely with his companions for his country and for science about March 25, 1912, stayed at Lautaret in March, 1908, to prepare for that memorable expedition."

As there will be no meeting of the British Association at home this year, it is proposed to hold in Edinburgh on Tuesday, September 8, and the four following days, a conference of observers and students of meteorology and allied subjects. One of the objects of the conference is to bring together observers in meteorology, climatology, oceanography, limnology, atmospheric electricity, terrestrial magnetism, and seismology, as well as persons who are interested in the discussion of the observations. Special attention is to be directed to the teaching of meteorology in schools and to the relation of meteorology to aviation. To ensure the success of the conference, it is important that the organising committee should know as soon as possible the names of those who propose to attend, and such persons are invited to communicate with Mr. F. J. W. Whipple, honorary secretary, at the Meteorological Office, South Kensington, S.W. The representative character of the organising committee, of which Dr. W. N. Shaw is chairman, and to which further additions are to be made, augurs well for the success of the conference.

It is with sincere regret that we record the untimely death of Major G. E. H. Barrett-Hamilton, which, according to a cable message received at the Natural History Museum, occurred on January 17 from heart failure in South Georgia, where the deceased naturalist was conducting an investigation into the whaling industry on behalf of the Colonial Office and the museum. Of Irish nationality, and inheriting a patrimony at Killmanock, county Wexford, Major Hamilton was born in 1871, and was educated, first at Harrow, and finally at Trinity College, Cambridge. Very soon after taking his degree—if not, indeed, before—he began to devote attention to the mammals of the British Isles, one of the earliest—if not the very earliest—of his papers being on the marten in Ireland, published in *The Zoologist* for 1894, while in the following year he established, in conjunction with Mr. O. Thomas, the distinctness of the Irish stoat. This line of research culminated in "A History of British Mammals," of which fourteen parts have been already issued, this being the only work in which the subject is treated on a thoroughly modern scientific basis, and which will remain as the best memorial to its talented author. In 1896 Major Barrett-Hamilton accompanied Prof. d'Arcy Thompson to Bering Sea, as the British representatives on the Fur-Seal Commission, in which capacity he did a large amount of excellent work. This no doubt led to his being appointed last summer to the aforesaid South Georgian whaling mission, on which he started in October.

The executive committee of the fourth International Botanical Congress, to be held in London next year, in conjunction with Dr. Briquet, the *rapporteur général* for the section of nomenclature, has issued a circular relating to the work of this section at the congress. This will consist in the completion of the rules of botanical nomenclature, issued as the result of the meetings at Vienna (1905) and Brussels (1910), by the settling of certain points left over from those meetings. The programme of work for 1915 was defined by the congress of 1910 as follows:—(1) To fix the starting point for the nomenclature of (*a*) Schizomycetes, (*b*) Schizophyceæ, (*c*) Flagellatæ, (*d*) Bacillariaceæ; (2) to compile lists of *nomina generica utique conservanda* for (*a*) Schizomycetes, (*b*) Algæ, (*c*) Fungi, (*d*) Lichens, (*e*) Bryophyta; (3) Compilation of a double list of *nomina generica utique conservanda* for the use of palæobotanists; (4) discussion of motions relating to new points which were not settled by the rules adopted at Vienna and Brussels. The carrying out of this work has been entrusted to two committees under the direction of a *rapporteur général*, Dr. J. Briquet (Geneva), assisted by Prof. H. Harms (Berlin). Copies of this circular, which contains lists of the committees and subcommittees for the various groups and other information, may be obtained from the general secretary, Dr. A. B. Rendle, British Museum (Natural History), Cromwell Road, S.W.

Detailed plans have been published for the work of the British Antarctic Expedition under Mr. J. Foster Stackhouse. The main object will be to ascertain something of what lies between King Edward VII. Land in the Ross Quadrant and Graham Land in the Weddell Quadrant, and whether the former is a part of the Antarctic continent, or insular. The expedition will use Scott's vessel, the *Discovery*, which is intended to leave London on August 1, 1914. She is to proceed by Cape Town and Bouvet Island, the Sandwich Islands, and South Georgia to the Falkland Islands, and thence to sail for Graham Land at the end of 1915. Here exploration and scientific work are to be carried on for a year or more, the *Discovery* meanwhile working south and east. The landing party, having been relieved and reprovisioned, will explore between Graham Land and King Edward VII. Land in 1916, and after wintering, a sledging expedition will make for the Bay of Whales in King Edward VII. Land, whence the *Discovery* will convey them home by New Zealand and the Panama Canal. Lieut. A. E. Harbord, R.N., will command the ship, and the party will include Lord Congleton, Captain A. S. Cantrell, Mr. W. H. Stewart Garnett, and Mr. D. H. Pearson, as surveyors and in other capacities, while the Master of Sempill will undertake meteorological work and also the care of the electrical and motor mechanical appliances. The expedition is expected home in the later part of 1917, and its total cost is estimated at 25,000*l*. If expeditions now in the Antarctic field or about to enter it should all succeed in their various objects, the next few years should bring a working outline knowledge of Antarctica.

MR. A. F. R. WOLLASTON on January 26 described before the Royal Geographical Society his journey in Dutch New Guinea in 1912. His principal object was to ascend to the snowy ridge of Mount Carstensz, and to see what lies beyond (which is unknown); in this he only just failed of success. A canoe accident (not the first of its kind on a New Guinea river) deprived him on his return journey of valuable records and effects. In spite of these misfortunes he has brought back much valuable information concerning the physical geography and biology of the country traversed (the Utakwa valley), and also its inhabitants. These last he divides into the coast people and the mountain people, who live at elevations from 4000 to 6000 ft. or more. He also encountered a third class, of wanderers believed to come from the west. The appearance and habits of the mountain people, and their struggle for existence, were vividly described. Mr. Wollaston was accompanied by Mr. C. Boden Kloss, of the Kwala Lumpor Museum, who undertook the zoological and botanical work; he also acknowledged much practical assistance from the Dutch authorities. As regards the physical features of the country, he commented (among much else of interest) on the remarkably complex structure of the foothills, and traced the diminution in the thickness of the jungle undergrowth at about 7000 ft. of altitude, the change from the lower forest trees to pandanus and casuarina at 8000 ft., and the disappearance of trees above 10,500 ft. His progress was stopped by precipitous rocks and an ice-wall at 14,866 ft., not 500 ft. below the summit-ridge.

THE issue of *The National Geographic Magazine* for January is wholly devoted to a finely illustrated article by Mr. F. E. Johnson, entitled "Here and There in Northern Africa." It contains a splendid series of photographs depicting the racial types, particularly those of the Ouled Nail dancing girls, whose performances are familiar to visitors to Biskra. The pictures of life in the harem and in the oases are very striking, while those of the moving sand-dunes with waves like those of the sea produced by wind action are of special interest.

PROF. DALL' OSSO, of Ancona, announces an important archæological discovery in the shape of a burial-place of the Stone Age in the Valle Vibrata, in the Abruzzi. The bodies were not buried, but laid in small huts containing from two to eight each, arranged on low platforms sloping towards the centre. With a single exception the bodies all rest on one side, with the knees drawn up, a position not unlike that of the crouching pre-dynastic Egyptian, in Case A of the first Egyptian room in the British Museum. The articles found with the remains, especially the vases and other utensils, indicate a higher degree of civilisation than has been observed in other instruments of the Neolithic age.

FURTHER accounts of the excavations conducted by the British Museum on the site of Carchemish indicate that the results are more important than was anticipated. The excavation of the Acropolis has been to some extent disappointing, because much was destroyed by Roman work in the second century. But a large building recently unearthed shows a continuous series of reliefs cut in slabs of white limestone and black diorite alternatively. We have processions of the king, his family, and attendants. These slabs, which technically contrast with Mesopotamian work in height of relief and broad simplicity of treatment, deserve comparison with the best Assyrian sculptures. Much more can be done if funds are forthcoming, and it may be hoped that immediate measures will be taken to complete these excavations, which promise to throw welcome light on the little-known Hittite culture.

DR. MILLARD's Chadwick Lectures on the subject of "The Vaccination Question in the Light of Modern Experience," are well worth careful reading. We dislike the phrase, "The Vaccination Question," for it conveys to many minds a vague notion that vaccination does not protect against smallpox. The only vaccination question is, whether "the Leicester method" can so ensure a community against smallpox that the community can wisely disregard the use of infantile vaccination. In forty years, Leicester has had only forty-six deaths from smallpox; that is very few. Doubtless, if these forty-six persons had been well vaccinated just before they were exposed to the disease, the number of deaths would have been not forty-six, but none. Dr. Millard rightly says that "in the rather remote contingency of a really serious epidemic of smallpox occurring again in Leicester, or in any town, he would advise everyone to get vaccinated, even though they had already been once vaccinated." But the phrase, "a really serious epidemic," implies a good deal of disease among those who have not got vaccinated. Doubtless, Leicester, with its magnificent sanitary service, and its not unnatural pride over its own health, and a cordon of less unvaccinated towns round it, is what one calls "fairly safe"; but contingencies, even remote contingencies, do sometimes take form in fact. We have to reckon with "unrecognised cases, especially when occurring in the tramp class," and with a host of our individual civic and domestic responsibilities, and with the bare possibility that the remnants of smallpox in this country may of themselves increase in strength.

VOL. VII. of the *Boletim do Museu Goeldi* (*Museu Paraense*), which relates to the years 1909–10, although only published in 1913, contains a narrative, illustrated by photographs of natives and scenery, of a journey from Xingú to Tapajoz, undertaken by Dr. E. Snethlage, as well as a report on scientific explorations in Pará by Mr. A. Dueke.

IN an article published in *The Egyptian Mail* of January 15 it is stated that, among other additions, the Giza Gardens have acquired a second specimen of the white-eared kob (*Cobus cob leucotis*) from the swamps of the White Nile. These two are believed to be the only examples of this antelope brought alive from the Sudan, the first having been received nearly two years ago. It is also mentioned that Mr. J. L. Bonhote, who joined the staff of the gardens some time ago, is at present rearranging the museum.

The report of the (Egyptian) Zoological Service for 1912 contains reproductions from photographs of some of the more interesting animals in the Giza Zoological Gardens. The Government, it appears, has been taking measures for the protection of certain kinds of birds, particularly the cattle-egret (*Ardea bubulcus*). That species has suffered so severely from the plume-hunters that in the spring of 1912 only a single breeding colony remained in the whole of Lower Egypt. Thanks, however, to protective measures, more than 500 young birds were bred under natural surroundings under the care of a watchman of the Zoological Service. In Upper Egypt one large breeding colony remains, and, as the watchman reported the presence of a very large number of young birds in the country, there may be others.

In *Symons's Meteorological Magazine* for January Mr. R. C. Mossman concludes the seventh of his interesting articles on southern hemisphere seasonal correlations, with some remarks as to the practical value of this class of research. He considers it almost certain that interaction is world-wide, but that even to-day there are not sufficient weather data for many regions. As an essential feature of this study a bipolar campaign is suggested, and also that the equatorial belt should be specially investigated. The method of using the preceding weather in one part of the earth as a means of arriving at a knowledge of what will subsequently take place in another part has already had practical application in determining the probable intensity of the Indian monsoon. He thinks that the establishment of a world-bureau is the only way to meet the situation, owing to the enormous labour involved; this question has, however, been discussed at several of the international meetings, but all efforts to found such an institution have hitherto failed.

The December number of *Terrestrial Magnetism and Atmospheric Electricity* contains the results of the determinations of magnetic declination made by the survey ship *Carnegie* on the voyage from St. Helena to Falmouth during the autumn of 1913. From these results it appears that the British chart of the Atlantic shows the westerly declination too small by about 0·7° over that part of the course between latitudes 5° south and 20° north, and about the same amount too great between 35° and 45° north. According to a note in the same number the *Carnegie* has now returned to New York, having completed her circumnavigation cruise of 70,000 miles commenced in June, 1910.

The introductory remarks on galvanometers and their properties with which the Cambridge Scientific Instrument Company prefaces its new catalogue of those instruments will prove of the greatest value to all who have to deal with electrical measurements. They cover such subjects as the period, the damping, the steadiness of the zero, the resistance, and the sensitiveness of the instruments, and furnish a sounder scientific basis for the choice of a galvanometer for any special purpose than can be found outside the scientific papers dealing with the subject. In order to compare different types of instruments a "factor of merit" is calculated from the behaviour of each. It is defined as one hundred times the deflection in millimetres per micro-ampere at a scale distance of a metre, divided by the square of the undamped periodic time in seconds and by the two-fifth power of the resistance of the instrument. The values are roughly one hundred for the Ayrton-Mather ordinary, 700 for the short-period instrument, 7000 for the Paschen, 150 for the Broca, and 100,000 for the Einthoven string instrument. In the last case the comparison is somewhat doubtful, as the deflections are read through a microscope, and not in the standard way described in the definition.

One of the subjects dealt with in a recent paper by Mr. B. Welbourn, entitled "British Practice in the Construction of High Tension Overhead Transmission Lines," and published in the Journal of the Institution of Electrical Engineers for January 15, was protection against atmospheric disturbances. He expressed the opinion that no necessity exists in this country for earth wire protection above the power lines, as experience has shown that lightning troubles are very few and no more frequent than are mechanical faults on underground cables. Horn gap arresters, with or without choking coils, erected in the open air, especially in industrial districts, he condemned as wrong in principle, as well as being untrustworthy. The extensive use of electrolytic aluminium arresters is limited by the fact that they need charging every day from the line. Moscicki condensers are coming into favour slowly, possibly because of their high first cost. A novel method which has been found satisfactory has been developed by Messrs. Merz and McLellan, who have discarded arresters on all lines which are connected to the system through transformers. About 10 per cent. of the end turns on the line side of these are insulated with special materials to a thickness of 300 to 400 per cent. of the insulation on the remaining turns. Atmospheric disturbances on the line are reflected back by the end turns of the transformers, and the oscillations are damped out by the ohmic resistance of the line.

The Mathematical Association has issued a catalogue of the current mathematical journals of all countries of the world, with lists of the libraries in Great Britain where they are taken in, and the dates at which the series commence and terminate when discontinued. This valuable little pamphlet is published by Messrs. G. Bell and Sons, Ltd., London, price 2*s*. 6*d*., and editorial communications for insertion in future issues are to be sent to Mr. W. J. Greenstreet, The Woodlands, Burghfield Common, near Mortimer, Berks. The present catalogue is issued on the understanding that it contains a first draft of the titles of current mathematical periodicals. Many periodicals of a general character containing mathematical articles are also included in its scope, though publications such as those of our Royal Society are excluded. The catalogue should be in every public library and in the library of every mathematician; it contains 182 entries.

In a recent issue of *The Chemical News* (vol. cix., p. 37, January 23, 1914), Dr. J. C. Cain describes some new experiments on the estimation of alcohol in beer by Malligand's ebullioscope. This instrument was invented in 1874, and tested thoroughly at that time with French wines and with German and Scandinavian beers, but appears to have been almost forgotten. The percentage of alcohol is determined by its influence in lowering the boiling point of the water; the solid contents of the wine and beer, being of high molecular weight, are almost without effect on the boiling point. The thermometer is provided with a movable scale, which can be set to correspond with the boiling point of water as it varies with changes in the barometric pressure. It is calibrated directly to correspond with percentages of alcohol, so that no tables or calculations are required. The whole determination can therefore be carried through in a few minutes by anyone who is capable of reading a thermometer. In a series of twenty-two analyses, the percentage of alcohol found in this way was usually within 0·1 per cent. of the percentage determined by the standard method of distillation.

The properties of alcohol and of stimulants in general in relation to their physiological effects form the subject of an address, given by Prof. H. E. Armstrong to the Institute of Brewing, which is printed in the December issue of their journal. The account given of the power of alcohol and its homologues, when used in moderate amounts, to penetrate the membrane which encloses the cell is a clear statement of facts which will have to be considered by the physiologist, and should do something to overcome the prejudice against alcohol which exists in the minds of otherwise fair-minded people. The ill-effects produced by alcoholic beverages are more probably to be ascribed to the presence of small proportions of still more active substances. The action of alcohol and similar hormones is to accelerate the rate of passage of water and diffusible substances through the cell walls. Probably the ordinary changes involved in the life of the living cell cannot go on without some kind of stimulus from without to disturb equilibrium, so that, particularly with a simple diet, some form of stimulant must be taken with the food. Such stimulants are not necessarily alcoholic, as one of the most common digestive stimulants is carbonic acid—*e.g.* aerated waters. Excess of such stimulants are contained in meat extracts, the supposed body-building power of which is almost entirely fictitious, being due to an increased proportion of water in the cells.

The strength of stayed flat plates forms the subject of a report issued by Mr. C. E. Stromeyer, chief engineer of the Manchester Steam Users' Association. Mr. Stromeyer has analysed and correlated a number of experiments on this subject, and suggests empirical formulæ for practical use. Some interesting information is included regarding working conditions. Thus, one of Mr. Stromeyer's inspectors examined recently a loco-portable boiler, and found that the firebox had wasted almost to the vanishing point. The thickness of the crown plate, as gauged by the inspector, varied from one-thirty-second to one-sixteenth inch, yet this flat plate had withstood satisfactorily a working pressure of 70 lb. per sq. in., the stays being pitched at $5\frac{1}{4} \times 4\frac{1}{2}$ in. centres. No bulging was reported. Reference is made to Bach's experiments, and we are reminded that fuller details of these experiments may be expected shortly.

Teachers of geography who have adopted modern methods of instruction should examine the coloured "Contour Hand Maps" of the counties of England and Wales which are being published at the price of 2*d.* net each by Messrs. G. W. Bacon and Co., Ltd. Judging from the eight specimen maps which have been received, teachers will have no difficulty in devising an abundance of practical exercises which will make easy to young people an appreciation of the relief of an area from a study of its contoured map.

OUR ASTRONOMICAL COLUMN.

Detonating Fireball of January 19.—Mr. W. F. Denning writes:—"A few minutes after 7 p.m. on January 19 a magnificent meteor was seen at Reading, Oxford, and other places in that part. It illuminated the sky with a brightness superior to the full moon, and startled many persons as the night had been very dark, and the transformation was almost instantaneous. The fireball traversed a long arc extending probably over 60°, at a slow rate of motion, the estimated duration being from five to seven seconds.

"A few minutes after the meteor had disappeared a heavy sound as of distant artillery was distinctly heard at many places, and there was a decided vibration of houses, the windows shook, crockery ware rattled, &c., as during an earthquake. At Oxford there was a loud report rather like thunder. At Finstock, Oxon., the noise is said to have resembled the boom of a heavy gun rather than a clap of thunder. At Shinfield, near Reading, and at other places in Berks, the doors and windows rattled. Certain persons who did not see the meteor thought that the disturbance was due to an earthquake shock. At Wallingford the sound followed the light three minutes, so that the explosion may have been about thirty-seven miles distant. This represents the motion of sound in ordinary air. In the rarer atmosphere of great elevations it travels much slower, and the distance may therefore have been greater. The fireball seems to have passed from N.E. to S.W. from Hertfordshire to Berkshire, at a height of about fifty-one to eleven miles. It had a luminous flight of about sixty-seven miles, and a velocity of about twelve miles a second.

"During the last fifteen years an unusually large number of fireballs have appeared in the month of January. Mrs. Fiammetta Wilson has informed me that there is an old Roumanian superstition that bolides may be abundantly observed from January 14–20, and especially on January 19."

Comet 1913*f* (Delavan).—Dr. G. van Biesbroeck, of the Uccle Observatory, sends to the *Astronomische Nachrichten*, No. 4711, his determinations of the parabolic elements and ephemeris of comet 1913*f*, discovered by Delavan. The former are based on observations made on December 19 and 29, 1913, and January 14 of this year, and the ephemeris satisfied the latest observation of this object made on January

22. The following is the portion of the four-day ephemeris for the rest of the present month :—

oh. M.T. Berlin.

		R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Feb.	13	2 38 59	+0 48·7	10·8
	17	39 27	1 31·0	,,
	21	40 11	2 13·8	,,
	25	41 9	2 57·0	,,
March	1	2 42 22	+3 40·7	10·8

The brightness is calculated on the assumption that on December 17 the comet was of magnitude 11·0.

DARK REGIONS IN THE SKY.—Prof. Barnard contributes some valuable observations regarding the appearance of the very dark areas in star clouds and nebulæ which have attracted attention from time to time. The number of such areas is quite considerable, and he promises at some future time to make a catalogue of them. In his paper to the current number of *The Astrophysical Journal* (vol. xxxviii., No. 5) he describes two of these remarkable areas, namely, one in the star cloud of Sagittarius, and another in the nebulous stream south of ρ Orionis. While photographs of the Sagittarius star cloud show a small and definite spot, Prof. Barnard has made numerous visual observations and has been led to the result that the object is not a vacancy among stars, but a more or less opaque body. With regard to the second dark area, the dark notch in the nebulous stream is, as he says, "clearly a dark body projected against and breaking the continuity of, the brighter nebulosity." He further states :—"Possibly this is a portion of the nebula itself nearer to us, but dark and opaque, that cuts out the light from the rest of the nebula against which it is projected." Visual observations by him with the 40-in. refractor confirmed his view that an obscuring medium was the origin. It is interesting to direct attention to the photographs of some spiral nebulæ seen edgewise as photographed by Dr. Isaac Roberts, such as HV 24 Comæ Berenicis, where it is stated, "the photograph shows the nebula to be, almost certainly, a spiral viewed edgewise, the dark line across it being caused by the fainter portion of the nebulous convolutions being now turned towards the earth; they would thus be dense enough to obscure the nucleus and its surroundings, but not bright enough to impress the film, they thus appear as a dark line." Markings somewhat analogous to that described by Prof. Barnard in the nebulous stream of ρ Orionis are illustrated in Roberts's nebulous region round the cluster N.G.C., Nos. 2237–39 Monocerotis, in which "black tortuous rifts meander through the nebulosity . . . margins are sharp and well defined . . . like cleanly-cut cañons."

A REVIEW OF GEOGRAPHICAL REVIEWS.

BY means of a brief survey of some of the more important articles which have appeared in recent issues of leading foreign geographical periodicals, it is possible to compare and in a measure contrast the trend of geographical study in different countries. We may broadly classify such articles mainly under the departments of (1) travel and exploration, wherein travellers present general accounts of their observations and experiences, (2) physical geography, (3) human geography, and (4) cartography and geography. It is to be expected that at the present stage of the world's progress the department of travel should be finding a place of lower importance relatively to the rest than that which it formerly occupied; it is also natural that this tendency should be more clearly remarked in foreign publications even than in our own *Geographical Journal*, in view of our wide territorial interests.

During the past year, however, we find evidence in all the geographical publications under notice of the international character of the interest in Arctic and Antarctic research, with especial reference to the work of Filchner in *Petermanns Mitteilungen*, and of V. Stefánsson in the Bulletin of the American Geographical Society, together with universal appreciation of the results of Scott's expedition. For the rest, Dr. F. Kühn dealt at some length in the *Mitteilungen* of July with his visit to the Cordillera of San Juan, Argentina, and in *La Géographie* (the bulletin of the French Geographical Society) we have a steady record of French activities in Africa, such as the account of the Mission Rohan-Chabot in Angola (January), Capt. Niéger's "Mission d'études du transafricain" (February), M. le Terrier on the lakes of the Lower Ogowe (June), and H. Roussilhe's account of the "Mission hydrographique Congo-Oubangui-Sangi" (August).

Physical geography shares with travel the pages of the French publication almost exclusively (so far as concerns leading articles); the direction of this branch of study is in general towards detailed work in limited areas, a tendency which is also very clearly marked in the *Bolletino della Reale Società Geographica* (Italy) and the American Bulletin, for in both these countries this department of geographical study stands, as in France, in an eminent position. In all three the limitations of geomorphology appear to be clearly recognised; the land-form, not its geological composition (at least not primarily) is the subject of investigation. Examples are Sumner Cushing's study of the east coast of India (Bulletin, February), the Ohio floods of 1913, by Robert M. Brown (*ibid.*, July), Etienne Clouzot's "Modifications littorales de l'île de Noirmoutier" (*La Géographie*, January), P. Lemoine's "Régions naturelles du département du Gard" (*ibid.*, March), R. Blanchard's "Morphologie du Caucase" (*ibid.*, June), while in all three countries it is clear that growing importance is attached to the branch of potamology; while climate, vegetation, and (in France) glaciers, also provide material for study.

The department of human geography holds a markedly more prominent place in the *Mitteilungen* than in other journals; perhaps the most important contribution to it has been Dr. L. Weise's notice and map of the distribution of population in Europe (January); the recent census (as in other countries) has been made the basis of other geographical studies, such as Prof. F. Auerbach's "Gesetz der Bevölkerungskonzentration" (February), and Dr. Olbricht's "Die deutschen Gross-Städte" (August), while among other studies mention is due of Prof. Cvijic's close, and at the present moment of history peculiarly valuable, survey of the ethnographical boundaries in the Balkan peninsula (March *et seq.*) From the American Bulletin may be quoted Mark Jefferson's "Anthropogeography of North America" (March), and Mary Dopp's "Geographical Influences in the Development of Wisconsin" (June *et seq.*). In Germany and America this department is clearly more strongly developed than elsewhere.

In the department of cartography we turn naturally for guidance to Germany; it is perhaps a sign of grace that a writer in the American Bulletin, Martha K. Genthe, has done the same by contributing a "Note on the History of Gotha Cartography"; American cartographers, at any rate on the commercial side, have notoriously much to learn and to unlearn, while A. Briesemeister's large map of the

Arctic regions, presented with the Bulletin, possesses no marked merit.

Before closing this notice, reference must be made to Prof. K. Haussmann's "Die magnetischen Landesaufnahmen im Deutschen Reich und magnetische Uebersichtskarten von Deutschland in 1912" (*Mitteilungen*, January–April), and to the regular supplement on military geography in the same journal, which (apart from the interesting and suggestive fact of its mere existence) shows that that branch of study is by no means a preserve of military men.

WIRELESS TELEGRAPHY.[1]

(1) OF the last four parts of the sixth volume of the *Jahrbuch der drahtlosen Telegraphie und Telephonie*, part 3 is almost wholly devoted to an account of the doings of the recent International Radio-telegraph Conference in London, and of the fruits of their labours. In part 4 there is a return to scientific and technical matters, the principal article being one which concludes an elaborate piece of work, both theoretical and experimental, by F. Müller, on the oscillations in three coupled circuits. Part 5 contains several articles of interest. One, by S. Loewe, on the calibration of thermo-elements for accurate quantitative work—chiefly in connection with the measurement of small high-frequency currents—may be useful to others than those in Hertzian research. A very elaborate technical study of a resonance inductor for use with alternating current of 1000 periods per second is contributed by S. Kimura. An article by G. Seibt describes apparatus for the exhaustive testing of mineral substances with a view to their usefulness as detectors of electrical oscillations. Part 6 contains a paper by P. Jégou on the utility of acoustic resonance in wireless telegraphy—a matter that has received considerable attention of late on account of the widespread use of rapid sparks, producing musical notes, in signalling. F. Kiebitz contributes two articles, one dealing with an elaboration of Bjerknes's method of measuring the decay coefficient of a circuit, the other describing new experiments on antennæ consisting of long wires stretched horizontally at a height of a few metres above the surface of the earth. It is found that the state of the ground under the horizontal antennæ greatly affects the efficiency with which such antennæ can radiate. This article is followed by an interesting correspondence on the same subject.

(2) A new edition of the official handbook for wireless telegraph operators, revised in accordance with the International Radio-telegraph Convention of London, 1912, has recently been issued by the Postmaster-General. It contains eighty pages, and is sold at 3*d*. Though it does not in any way deal with scientific principles or technicological details, it will be found of interest to everyone connected in any way with wireless telegraphy. Very full instructions are given concerning the calculations of rates and of the routine of transmitting a message; this will be of interest to those of the general public who have occasion to use radio-telegraphic facilities. The comprehensive tables and lists of abbreviations to be used for commonly occurring phrases, are absolutely indispensable to the amateurs who amuse themselves by tapping other people's messages. The book closes with the regulations of the examinations for qualification as an operator on board ship.

[1] (1) "Jahrbuch der drahtlosen Telegraphie und Telephonie." Herausgegeben von Dr. Gustav Eichhorn. Band 6, Heft 3–6. (Leipzig: J. A. Barth, 1913.)]
(2) "Handbook for Wireless Telegraph Operators Working Installations Licensed by H.M. Postmaster-General." (London: Wyman and Son, Ltd., 1913.) Price 3*d*.

THE PRESERVATION OF NATURE IN GERMANY.

IN 1907 the Prussian Ministry of Education instituted the Central Office for the Care of National Monuments. The office is in the old Botanical Museum in Berlin, and it contains, besides other rooms, a library and a large hall for meetings and lectures. The staff includes a director, two naturalists, a lawyer, librarians, and clerks. Associated with the Central Office there are in the provinces of Prussia forty local committees, on which are representatives of the Imperial Government, the local administration, the agricultural and forestry departments, and the local universities and museums. The provincial committees are not supported financially by the State; they receive, however, small grants from the provincial administrations for the purpose of working expenses. The aims of the Central Office are:—(1) To discover the existence of natural monuments[1] and to investigate and preserve them; (2) to make records of their situations and the conditions of their ownership; (3) to make maps and photographs of them for permanent preservation in the office; (4) to form a collection of all the literature dealing with the dangers threatening such places and their prevention, the laws relating to the ownership of land, and any scientific books discussing in particular the areas reserved or worthy of reservation.

The publications of the Central Office are two. "Beiträge zur Naturdenkmalpflege" contains the report of the office and of the work done in foreign countries; it is circulated principally among scientific people and administrative officials. "Naturdenkmäler, Vorträge und Aufsätze" ("Natural Monuments, Lectures and Essays") is written in a more popular style, with the purpose of carrying the ideals of a love of nature among all classes of the people. Besides these periodical publications, lectures which have been held under the auspices of the office are printed and circulated in the form of pamphlets, and many provincial committees print and distribute "communications" in their own spheres of work. Courses of instruction are held from time to time at the Central Office, chiefly for the information of strangers, and every week debates are held, which are attended by residents in Berlin who are interested in the work. The department works hard to make all classes interested in the work, and in this it receives great assistance from the Administration of State Forests, the employees of which are made acquainted with the trees of scientific as well as of economic importance.

The General Order of 1907 empowered the provincial representatives of the Imperial Government to start reservations of forest, and to provide that those regions be dealt with differently from the ordinary scheme of forestry, with a view to the preservation of rare plants and animals. As a consequence of this order a large number of reservations of greater or less extent, which lack of space prevents us from enumerating here, have been laid out. It has wisely been decided that size alone is not a necessary condition of a reserve; a single tree or the face of a cliff may well be worthy of that dignity. Not only the Department of Forestry, but those of Agriculture, of Constructions, or War, and even the churches, both Protestant and Catholic, have helped to further the ends of the Central Office. What has been said above of the work done in Prussia is true also of Bavaria and Wurtemberg, and, to a less extent, of some of the smaller States of the German Confederation. This

[1] Under this title are included any natural objects of interest, whether botanical, zoological or geological, particularly those which have survived in their primitive state, untouched by civilisation.

result is doubtless due, in a great measure, to the efforts of the director of the department, who has taught his fellow-countrymen that the preservation of the natural beauties of their country for future generations is a national and a patriotic duty.

THE STUDY OF THE STARS.[1]

THE object of the American Association is the advancement of science. This is a very different matter from the diffusion of human knowledge. The universities and colleges provide liberally for the latter subject, but neglect the former almost entirely. Science is advanced by many individuals who hold offices in the universities, but seldom as a part of their official duties. Few professors are allowed to regard research as a portion of their college work, and still less frequently are appropriations made, or funds provided for original investigation. Astronomy is almost the only exception to this rule, and even here, in general, the time of the officers is mainly devoted to teaching. Observatories devoted to research, like Lick, McCormick, and Harvard, are supported by funds given specifically for their use, and receive little or no aid from the general funds of the universities with which they are associated. It is probable that American universities devote one hundred times as much money to the diffusion of human knowledge as to its advancement. The great progress made in America in some departments of astronomy is due to the fact that certain wealthy men and women have been willing to give large sums of money for this object. No other country is so fortunate in this respect, although in recent years, in Germany, large appropriations are being made by the Government for similar purposes.

The income of certain funds, like the Elizabeth Thompson, Bache, and Watson funds, are also available, but while these are of the greatest value in aiding particular individuals, the amount is too small to advance materially the entire science. The large funds which might aid individual research are unfortunately employed for other purposes. Scarcely any appropriations have been made to women from these funds. One of the greatest needs of science in America is a fund of moderate size, capable of aiding the men of real genius. The number of such men is not large, and a judicious distribution of a few thousand dollars annually would probably yield greater results than could be attained in any other way.

A visit to Europe last summer in order to attend the meetings of two national and two international astronomical societies, enabled me to visit several of the larger observatories and to interchange views with the leading astronomers of the world. I have accordingly selected as my subject for this evening, "The Study of the Stars," and I shall endeavour to transmit to you the latest views, as well as the history, of this department of human knowledge. It is my wish to present to my professional friends certain facts of a technical nature, and at the same time to make them clear to those of my hearers who have no previous knowledge of the subject. Astronomy has been called not only the oldest of the sciences, but that which has conferred the greatest benefits on man by rendering international commerce possible. While this may be true of the past, the value of the astronomy of the present day lies in its extension of human knowledge and enabling the mind of man to traverse fields which until recently appeared to be hopelessly beyond his ken.

[1] Address delivered at the Atlanta meeting of the American Association for the Advancement of Science, December, 1913, by the retiring president, Prof. E. C. Pickering.

The first catalogue of the stars was made by Hipparchus about B.C. 128, and was inserted by Ptolemy in the "Almagest," for fourteen centuries the authority in astronomy for the world. This catalogue, which contained more than a thousand stars, gave both their positions and brightness. The earliest copy that is known of the Almagest is in the "Bibliothèque Nationale" in Paris. It is a beautiful manuscript in uncial characters of the ninth century. The other later manuscripts unfortunately differ from it and from each other, so that there is some uncertainty regarding two-thirds of the stars, owing to errors of copying. A careful study of these discrepancies has been made by Dr. Peters, of Clinton, and Mr. Knobel, of London. Each spent several years on this work, and all the papers are in the hands of Mr. Knobel. He is now preparing the entire work for publication, and it is hoped that it will be in the hands of the printer in a few months.

A manuscript of nearly the same age is in the library of the Vatican, and this year a revised edition of it has been published. If we had a correct copy of the original work, it would have a great value at the present time. Half a century ago it would probably have given the best existing values of the proper motions of the stars which it contained, but recent observations enabled us to compute their positions in the time of Hipparchus, more accurately than he could observe them, assuming that the motion was rectilinear. This work, however, throws light on a possible curvature of the motions. The observations by Hipparchus of the light of the stars have a value that will be considered later.

The first accurate measures of the positions of the stars were made in the middle of the eighteenth century. The catalogue of Bradley in 1755 is even at the present time one of the best means of determining the early positions of the stars. A large number of similar, but later, observations by Hornsby are still unpublished. During the next hundred years the meridian circle, which is at present the standard instrument for determining the places of the stars, was gradually evolved. In this instrument a telescope is mounted so that it will point only to stars in the meridian, that is, to stars exactly north or south of the observer. The declinations of stars, corresponding to the latitude of points on the surface of the earth, are then measured by a finely graduated circle. Owing to the motion of the earth all stars cross the meridian twice during every twenty-four hours. The right ascension, corresponding to longitude, will be given by the time of transit. At first, this time was found by the "eye and ear" method in which the observer counted the ticks of an accurate timepiece and compared them mentally with the instant at which the star appeared to cross a wire in the field of view of the telescope. About the middle of the nineteenth century a great advance was made by recording the time electrically on a chronograph. This method was known for many years as the "American" method, owing to its introduction and general adoption in this country. This continued to be the standard method almost to the present time, and an enormous number of observations have been accumulated in this way, the total cost amounting to millions of dollars.

Perhaps the most valuable work of this kind is that of the Astronomische Gesellschaft, which, by international cooperation, secured accurate observations of the positions of one hundred and sixty-six thousand stars. All stars of the ninth magnitude, and brighter, north of declination $-23°$, are included. Of the twenty zones, seven were observed in Germany, four in the United States, three in Russia, one each in Algeria, Austria, England, Holland, Norway, and

Sweden. Of the American zones, one was observed at Albany, one at Washington, and two at Cambridge. Each of the latter occupied the time of an observer and several assistants for twenty years. It was expected that these stars would be re-observed after an interval of about fifty years, to determine the proper motions, or annual changes in position. As the time is approaching when this great work should be undertaken, careful consideration should be given to it.

Fortunately, the twentieth century has already developed two new methods, which might replace the older plans. The first of these is the transit micrometer, in which a motion is given to the wire in the field of the telescope, so that it shall follow closely the motion of the image of a star as it transits through the field. A wide difference of opinion exists among leading astronomers as to the best method of securing this motion. In the earlier instruments constructed by Repsold, the motion was given by a screw turned by the two hands alternately. This method certainly gives excellent results, and is still used largely in geodetic work. Anyone who has tried it will find that with the rapid motion of an equatorial star under a high power, it is difficult to satisfy himself that the wire always bisects the star. If clockwork is used, the rate must vary with the declination, and it is strange that this is not done by electrical control instead of the somewhat crude mechanical devices now employed. The wire records its position automatically on a chronograph at short intervals. The plan of permitting this record only when the observer is satisfied that coincidence takes place, as is done at Heidelberg, seems a good one. Evidently a certain relative motion will give better results than a greater or less motion. It would appear to follow logically that this apparent motion should be given to all stars and the record permitted only for the few seconds of apparent coincidence. We can expect no better results than those obtained with a filar micrometer. The best plan may therefore prove to be to give a motion to the wire nearly equal to that of the star, whatever the declination of the latter, by a suitable variation of the clockwork. The best rate could readily be determined by observing stars at different distances from the pole. Successive settings should then be made as with a filar micrometer, closing the circuit on the chronograph only when the bisection was satisfactory. A similar setting should also be made for the declinations. The two coordinates could thus be determined with an accuracy substantially the same as that of a filar micrometer. Experience has shown that one star a minute can be observed in both coordinates with the transit micrometer. There can be little doubt that positions could thus be obtained with much greater accuracy than by the methods now in use. The special advantage would be the elimination of systematic errors.

A second method of determining positions, recently developed at the Allegheny Observatory, is by plates taken with a photographic doublet. Ordinary plates must be replaced by those of plate-glass. By taking suitable precautions positions may be determined of even the faintest stars, with an accuracy at least equal to that of a meridian circle. To obtain the best results, the field should be about 5° square on an 8×10 plate. The focal length of the telescope would accordingly be about two metres. The large field would permit the constants of each plate to be derived from stars as bright as the eighth magnitude. The economy of this method would be very great, as compared with a meridian circle. The usefulness of the latter instrument appears to be confined to observations of the brighter stars. Accordingly, its aperture may be reduced. The ideal plan would apparently be to divide the sky into regions 5° square, and select in each five or more stars of about the eighth magnitude, and of approximately the same class of spectrum, as class K, so that all should have about the same colour. The positions of these should be determined with the greatest possible accuracy with meridian circles, as described above. Some brighter stars should be included to render available the vast number of observations of these objects made in the past. Positions of the stars in the Gesellschaft catalogues and all fainter stars should be determined by photography.

Various attempts are now being made to determine the absolute positions of the stars by means of photography. It appears probable that a pier placed under ground will remain free from irregular motions, and that if this can be accomplished, the absolute positions of the stars near the equator can be found by photography. To determine the equinox, Venus and Mercury should be photographed, as well as the sun. By the very satisfactory cooperation of the Princeton, Yale, and Harvard Observatories, the position of the moon is now determined by photography. The results of a preliminary discussion indicate an accuracy at least equal to that of the best meridian determinations, those of the Greenwich Observatory.

Excellent progress is also being made in determining the parallax of the stars by photography. The recent increase in accuracy is at least tenfold, or that of another place of decimals. A hundredth of a second of arc can be determined with greater accuracy than a tenth of a second twenty or thirty years ago.

The just criticism has been made of American astronomers that while they have contributed more than their share of the work in astrophysics, the older science of astronomy of position has been greatly neglected. This is partly due to the fact that much of this work has been left to the United States Naval Observatory, which in the past has failed to justify the liberal appropriations made for its support. While Congress has given it for many years a much larger income than that of any other observatory in the world, the law has been such that it is impossible to attain the best results. The superintendent must be a naval officer, instead of an astronomer, and even then must go to sea after a short term. Accordingly the Naval Observatory during a period of thirty-seven years had twenty superintendents with an average term of fewer than two years. The Greenwich Observatory during a period of 235 years, from 1675 to 1910, has had eight Astronomers Royal, with an average term of twenty-nine years. The work of the latter institution with but half the income has greatly exceeded that of the Naval Observatory. It should be stated, however, that within the last few weeks the Naval Observatory has established an admirable wireless time service, by which anyone, at trifling expense, can obtain accurate time within a tenth of a second. The Navy has no need of a great observatory, from which it derives but little credit. Three successive Boards of Visitors have pointed out the present unfortunate conditions, but the necessary action has not been taken by Congress. The obvious remedy is to remove the observatory to another department, or place it under the direction of the Smithsonian Institution, and appoint an astronomer at its head. What grander field of work could be undertaken by this observatory than that desired by astronomers and neglected elsewhere? For instance, computers of double-star orbits are continually complaining that while a surplus of measures of the easy objects are available, many difficult objects are neglected, although measures of them are greatly needed. The same is true of the asteroids, of variable stars, and, in fact, in almost every department of astronomy.

By making the observations desired by experts, every hour would be saved, and work of the greatest value accumulated.

Astrophysics assumed prominence as a science about forty years ago, although it was foreshadowed by certain far-seeing astronomers, like the Herschels, G. P. Bond, Huggins, Draper, and others. One department, the study of the light of the stars, was developed much earlier, originating in the Almagest, and its revision a thousand years later by Sûfi. These catalogues show that the relative brightness of the stars has not changed sensibly during the last two thousand years. Also, that the human eye has the same sensitiveness to different colours now as then. Stellar brightness was made a precise science by that great astronomer, William Herschel. His six catalogues, two of which remained unknown for eighty years, give precise measures of the light of the three thousand stars contained in them with an accuracy comparable with recent work.

In 1877, stellar photometry was taken up on a large scale at Harvard. Since then, more than two million photometric settings have been made. A station in Arequipa, Peru, permitted the southern stars to be observed on the same system as the northern stars. We have now, accordingly, measures of about eighty thousand stars, including all the seventh magnitude and brighter, many of the ninth magnitude, and some as faint as the thirteenth magnitude. The excellent work of the Potsdam Observatory gives measures of the light of fourteen thousand stars, including all northern stars of the magnitude 7·5 and brighter. The Potsdam and Harvard systems agree admirably if a correction is applied for the colour, or spectrum, of the stars. They should never be combined, or compared, unless this correction is applied.

Stellar photography, originating in the work of George Bond in 1857, has revolutionised many departments of astronomy. The great work of a chart of the entire sky, undertaken by the Paris Observatory in cooperation with several others, is a sad example of the danger of undertaking a work on too large a scale. Although several observatories have been continually at work upon it for a quarter of a century, it has been predicted that at least fifty years must elapse before it is completed, and no positions of any southern stars have yet been published. In striking contrast to this is the early completion of the Cape Photographic Durchmusterung, which gives the positions and magnitudes of nearly half a million stars south of $-19°$. It illustrates the results of the happy combination of skilful planning with routine organisation, conducted on a very large scale. The extension of this work to the north pole is now being planned, but with the additional condition that the colour index, as well as the photographic magnitude, will be determined. The former will be found by photographing the stars by means of their yellow or red, as well as their blue, light, the difference in the magnitudes giving the colour index.

Much might be said of the numerous applications of photography to the determination of stellar magnitude. The 60-in. reflector of the Mount Wilson Observatory, using exposures of several hours, has succeeded in photographing stars as faint as the twentieth magnitude. An international committee, with members from England, France, Germany, Russia, Holland, and the United States, has adopted a scale of magnitudes based on two investigations made at Harvard. One of these was made with the meridian photometer, and the other is an elaborate investigation by Miss H. S. Leavitt of the photographic magnitude of seventy-six stars near the north pole. A standard scale is thus provided from the first to the twentieth magnitude. We may say from the minus twenty-sixth to the twentieth magnitudes, since accordant results for the light of the sun have been obtained by Profs. W. H. Pickering and E. S. King. For many purposes photography may well replace visual photometric measures, since for stars brighter than the fifteenth magnitude photographs may be taken with yellow light.

One of the principal uses of measures of the light of the stars is the study of the variables, or those in which the brightness is not constant. A bibliography of these by Miss Cannon is recorded on about forty thousand cards. The number of known variables is now about forty-five hundred, of which three-quarters have been discovered by photography at the Harvard Observatory. There are several kinds of variable stars. Variables of long period undergo changes which repeat themselves somewhat irregularly in a period of several months, and at maximum are often several thousand times as bright as at minimum. The most useful work that an amateur can do with a small telescope is the observation of those objects. An important work undertaken by members of the British Astronomical Association has been the observation of variable stars. During the last thirteen years they have accumulated twenty thousand such observations, all reduced to the same scale, which is that of the Harvard photometry. Similar work in the United States has accumulated ten and sixteen thousand observations respectively in the last two years.

Variables of short period complete their changes in a few days, or hours. Prof. Bailey has found five hundred such objects in the globular clusters. In one of these clusters, Messier 3, out of a thousand stars one-seventh are variable, all have a period of about half a day, and their periods are known within a fraction of a second. Their light changes so rapidly that in one case it doubles in seven minutes. It is a strange thought that out of a thousand stars, looking exactly alike, there should be a hundred little chronometers keeping perfect time, and the rate of which is known with such accuracy. About a hundred and fifty variables belong to the Algol class, in which the light is uniform for a large part of the time, undergoing a sudden diminution at regular intervals. This is due to the eclipse of two bodies, one darker than the other, revolving around their common centre of gravity. An elaborate theoretical study of this problem has been made at the Princeton Observatory, and, from the photometric and photographic magnitudes made at Harvard and elsewhere, the dimensions of a large number of these systems have been determined.

Photography still can scarcely compete with other methods where the greatest accuracy is desired, as, for instance, the measures with the polarising photometer by the late Oliver C. Wendell. The masterly use of the selenium photometer by Prof. Stebbins gives results for bright stars of still greater accuracy, while the experiments in Germany with the photo-electric cell by Rosenberg and Guthnick give results which promise to revolutionise our present methods. The principal source of error appears to be the varying transparency of the air. The trial of the instrument in a location where the air is exceedingly clear and steady for long periods is greatly to be desired.

During the last twenty-five years photographs have been obtained by the Harvard Observatory in order to furnish a history of the stellar universe. Two similar 8-in. photographic doublets have been used, one mounted at Cambridge for the northern, and the other at Arequipa, for the southern stars. With each of these instruments about forty thousand photographs have been taken. The total weight of these plates is about forty tons. As each plate covers a region 10° square, every part of the sky has been photographed, on the average, a hundred times. This work is now supplemented by two small Cooke anastigmat lenses, each having a field 30° square. The number of plates taken with these two instruments are nine thousand and fourteen thousand respectively. The exposures with the larger instruments are, in general, ten minutes, showing stars of the thirteenth magnitude. The exposures with the smaller instruments are one hour, showing stars of the eleventh magnitude. A continuous history of the sky is thus furnished from which the magnitude and position of any stellar object of sufficient brightness can be determined for a large number of nights during the last quarter of a century. A striking illustration of the value of this collection occurred when the planet Eros was discovered in 1898. It appeared that this object was nearer the earth in 1894 than would occur again for thirty-five years. An examination of the photographs showed its presence on twenty-three plates, and from their positions, the parallax of the sun and mass of the earth were determined with an accuracy equal to that of any of the methods previously used, and on which an enormous amount of time and money had been spent.

For many years the Kiel and Harvard Observatories have served as distributing centres of astronomical discoveries and observations in Europe and America, respectively. The last new star which is known to have appeared, Nova Geminorum No. 2, was discovered by Enebo at Dombass, Norway, on Tuesday, March 13, 1912. The cable message was received at Cambridge on Wednesday morning, and the star was observed at several American observatories the next evening, or the night following its discovery. An examination of the Harvard photographs showed that two plates had been taken on the preceding Sunday, March 11, on which no trace of the nova was visible, and two on Monday, March 12, showing it of nearly its full brightness. Photographs taken on Wednesday compared with those obtained a few days later showed the wonderful change in its spectrum, from the solar type with dark lines, to the typical spectrum of a nova with bright lines.

There is no department of astronomy which is now receiving greater attention than the study of the spectra of the stars. Dr. Henry Draper was the first to photograph the lines in a stellar spectrum, although Sir William Huggins had already obtained a mark from the spectrum of Sirius, and later was the first to publish his results in successfully photographing stellar spectra. The untimely death of Dr. Draper in the midst of his work led to the establishment at Harvard of the Henry Draper Memorial. For nearly thirty years Mrs. Draper has maintained an active interest in this work. By placing a large prism over the objective of a telescope, the light of all the brighter stars in the field are spread out into spectra, so that instead of photographing the spectrum of one star at a time, as with a slit spectroscope, as many as a thousand have sometimes been taken on a single plate. Such photographs, covering the entire sky, have been taken with the two 8-in. doublets already mentioned. A study of the spectra thus obtained enabled Mrs. Fleming to discover many hundred objects the spectra of which are peculiar. Among them may be mentioned ten of the nineteen new stars known to have appeared during the years in which she was engaged in this work, while five of the others were also found at Harvard by other observers. She discovered more than two hundred variable stars, ninety-one out of the 108 stars of the very peculiar fifth type, and showed that these objects occurred only very near the central line of the Milky Way. During the last two or three years a great demand has arisen for the class of spectrum of large numbers of stars. The Harvard photographs show the class of spectrum of nearly two hundred thousand stars. Miss Cannon has, accordingly, undertaken to prepare a catalogue of these objects, with the result that she has already classified about one hundred and fifteen thousand spectra, covering more than one-half of the sky. The work is progressing at the rate of five thousand stars monthly, and the results will fill seven of the large quarto Annals of the Harvard Observatory. The organisation of this work has required the most careful application of the principles of "scientific management."

One of the most important results derived from the Harvard photographs was the discovery that in certain spectra the lines were alternately double and single. This, and the discovery by Vogel at Potsdam that the lines of the variable star Algol continually changed their position, revealed the existence of spectroscopic binaries. No department of astronomy is receiving more attention, at the present time, than these objects, and in general the motion of the stars in the line of sight. The Lick, Yerkes, Greenwich, Potsdam, Bonn, and Ottawa Observatories are only a portion of those directing a large part of their energy to this subject.

One of the most important generalisations of recent times is the discovery by Prof. Campbell that the velocity of a star depends upon its class of spectrum. The proper motion of a star was similarly found by the late Lewis Boss to be dependent on the same quantity.

In conclusion, the United States has attained an enviable position in the newer departments of astronomy. Can this be maintained? In Europe, especially in Germany, observatories and instruments of the highest grade are now being constructed, the Government furnishing appliances with the most liberal hand. Perhaps the most promising sign for the future is the friendly cooperation of American astronomers, which has never been more marked than at the present time.

The possibilities of work are now greater than ever before. A small fraction of the effort expended in teaching science, if devoted to its extension and progress, would fulfil the objects of the American Association for the Advancement of Science.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A matter about which there is considerable divergence of opinion will come up for settlement this term. The Special Board for Medicine wishes to apply to the Board of Agriculture for a grant towards the medical department. Such grants are now commonly being made to the various medical schools in other parts of England, but Government grants mean Government control, and certain members of the Senate are apprehensive that Government control would mean an undue interference with the liberty of the University. On the other hand, similar grants, with the implied control, have already been accepted by the Cambridge School of Agriculture and by the department of astrophysics. The returns from the various colleges show that there are 330 medical students now in residence in the University. An examination of the figures relating to the grant made to three of the London medical schools for their full-time students affords evidence that the grant is about 14*l*. per annum a student. Taking these two figures, it may be calculated that the Cambridge Medical School would receive a sum of at least 4600*l.* per annum, which might be applied to the relief of its most urgent requirements. The heads of the various departments connected with the medical school have recently asked for a sum of 7000*l.* per annum to bring the manning and equipment of their departments up to date. It is obvious that no such sum could be expected, but a sum of 4600*l.* per annum would relieve the most urgent needs of the school, would render the teaching more efficient, and would enable research to be carried out in the medical school on a scale commensurate with the importance of the University.

The foreign mathematicians who attended the fifth International Congress of Mathematicians held at Cambridge in 1912 subscribed a sum to be devoted to a memorial of a permanent nature to the late Sadlerian professor, Dr. Cayley. Having in mind that the presidency of this congress so brilliantly carried through was the last public appearance of Sir George Darwin, his colleagues in the administration of the congress have desired to provide a memorial of his work in the same connection. Accordingly a brass plate with armorial decorations has been prepared, and is now offered by Sir Joseph Larmor on behalf of his colleagues to the University. It is proposed to fix this brass in the chief mathematical lecture-room in the new Lecture Rooms Building.

The Botanic Gardens Syndicate again finds its income quite inadequate to the proper maintenance of the gardens. The increase in rates and taxes, in wages, and in the cost of fuel, is such that at the present time there is a deficit of 108*l.* In a report to the Senate the syndicate requests that the annual amount allowed to the Botanic Gardens be increased from 1350*l.* to 1500*l.*, and that the deficit be extinguished.

The Physiological Laboratory Building Syndicate has published a report giving details of the expenditure of nearly 1600*l.* on fittings for the new laboratory which is rapidly approaching completion. Further fittings and furniture, however, are needed, and the syndicate is asking for power to spend an additional 500*l.* which has been provided by the University Association.

DR. WARRINGTON YORKE has been appointed to the Walter Myers chair of parasitology, recently established in the University of Liverpool.

THE current number of *The Fortnightly Review* includes an article on continuation schools in England and Germany, which is a serious indictment of the conditions prevailing in this country with regard to the provision made for the continued education of children on leaving school at fourteen years of age, and in respect of the advantage which is taken of such provision, and a very unfavourable comparison is drawn with the conditions prevailing in Germany. We have been accustomed to believe that in respect of provision for evening education we have been easily in the front rank, but a glance at the figures presented by the Board of Education in its report for 1911–12 will dispel the illusion. There were but 708,000 students of all ages in the various evening schools throughout England and Wales, and of these only 307,000 were under seventeen, out of a total child population of these ages (not including those still at elementary and secondary schools) of not fewer than two and one-third millions, so that only 13 per cent. of the children at the most impressionable period of their lives were receiving continued education in any form. But this is not all, for the attendance, taking the average of the whole country, is miserably low. In the county boroughs the average number of hours of instruction received was fifty-eight, and in the administrative counties, forty-nine, whilst no less than 18 per cent., or nearly 124,000 pupils, received fewer than fourteen hours' instruction for the session. Throughout Germany, on the other hand, laws have been passed and are in active operation for the compulsory attendance for about 240 hours per annum, or six to eight hours a week, of all children who have left school and until they are seventeen years of age, chiefly in day continuation schools and *within* the hours normally devoted to labour, and the responsibility for the due execution of the law is laid upon the employer. The course is vocational and general. As an example of the success achieved in Berlin during the year 1910–11, there were 32,000 students in attendance at compulsory schools, in addition to upwards of 36,000 of both sexes at optional schools. In the new session of Parliament a Bill will be introduced, promoted by Mr. Chiozza Money and others, for the enactment of compulsory continued education of children who have left school until they reach seventeen years of age. It is to be hoped that the Bill will receive serious attention.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 5.—Sir William Crookes, O.M., president, in the chair.—Prof. L. **Hill,** J. **McQueen,** and M. **Flack**: The conduction of the pulse wave and the measurement of arterial pressure.—J. **Barcroft,** M. **Camis,** C. G. **Mathison,** F. **Roberts,** and J. H. **Ryffel**: Report of the Monte Rosa Expedition of 1911. I. Curves representing the equilibrium between oxygen and hæmoglobin were determined for *resting* individuals at Col d'Olen and the Capanna Margherita. These and all others were capable of representation by the equation

$$y/100 = \frac{K_x^n}{1 \times K_x^n}.$$

y = percentage saturation of hæmoglobin with oxygen; x = oxygen pressure; K = equilibrium constant of reaction; n = average number of molecules of Hb assumed to be in an aggregate. Notwithstanding a fall in the CO_2 pressure of the blood, no change in K could be detected, except as the mean of a large number of observations, when a slight fall in K, indicating decreased alkalinity of the blood, was apparent. The curves were determined in the presence of the existing alveolar CO_2 pressure. II. The blood was investigated similarly after *exercise*, which usually consisted in climbing 1000 ft. Climbs were made by the same individuals at—(1) Carlingford, co. Louth, from sea-level; (2) Col d'Olen, from 9000 ft. A diminution in K invariably occurred. Climbing at a given rate the reduction in K was much greater at high altitudes. A given reduction in K involved much more rapid climbing at low altitudes. The change in K caused by *exercise*, whether at high or low altitudes, was entirely accounted for by production of lactic acid. Determinations of the hydrogen ion concentration in the blood of one have been made. These show a defined relation between C_H and K, so that the one may be calculated from the other.—C. H. **Martin** and K. **Lewin**: Some notes on soil protozoa. Part i. The main purpose of this introductory paper is not the study of Amœbæ from a specific point of view, so much as the proof of the existence of a relatively frequent trophic Protozoan fauna in certain soils, and the rough indication of possible methods of dealing with this fauna. The startling success in the Lee Valley of the treatment of sick soils by partial sterilisation, introduced by Russell, would seem to present a very strong argument in favour of the view that these Protozoa do exercise an important influence on plant growth in these soils. The authors have been able to establish the occurrence of a trophic Protozoan fauna in certain field soils that they have examined, and to this question they hope to return in a future paper.—J. F. **Gemmill**: The development of the star-fish, *Asterias rubens*, L.—Dr. A. H. **Church**: The floral mechanism of *Welwitschia mirabilis*, Hook.

Institution of Mining and Metallurgy, January 15.—Mr. Bedford McNeill, president, in the chair.—C. W. **Purington**: The Bereozovsk gold deposit, Ural District, Russia. After a brief historical summary of the work done on the Bereozovsk estate, the author devotes considerable attention to the geological features, and especially to the occurrence of auriferous granite dykes which are more or less distinctive of this property. These dykes, of porphyritic rock of granitic type, in which is developed a considerable amount of schistosity, extend in a generally north and south direction, alternating with micaceous schist. In the immediate vicinity of the village is an area of pure granite; to the west are patches of listvenite, probably a metamorphosed dolomitic limestone; and in connection with the deposits occur bands of serpentine representing metamorphosed basic dykes. The quartz veins, worked for gold, penetrate the granite dykes (locally known as beresite), almost at right angles, and it is a curious fact that though these beresite dykes or lodes, to the number of 143, have been worked for gold over lengths ranging from 100 to 3000 ft., they only show gold values by virtue of the quartz veins which cross them. It is, in fact, not likely that the beresite is primarily auriferous, but it is so immediately situated to the intruding quartz veins as to have become impregnated by fissuring. Moreover, only within the limits of the beresite dykes are the quartz veins wide enough and rich enough to produce payable gold. The author deals with the geological problems attaching to this noteworthy occurrence.—J. Mackintosh **Bell**: The outlook for the mineral industry in Canada. For the purposes of his review, the author divides Canada into four sections, referred to respectively as the south-eastern, central prairie, western, and north central areas, and deals with these in detail. Of these, the first-named has a production almost entirely confined to coal. The central area also shows at present little metallic output. The western section, comprising British Columbia and the Yukon district, is of course notably mineral producing, but since 1907 the fourth of the author's arbitrary divisions, the north central, comprising Labrador, Ontario, Quebec, Manitoba, Saskatchewan, and part of the North-West Territories, has by the discoveries at Cobalt, Sudbury, and Porcupine, leapt into first place, though even now its latent possibilities are far from being fully realised. The author supplies much valuable information with regard to the mineral production of the various districts and as to the results to be expected when prospecting has been extended with the growth of the railroad systems of the Dominion.

Geological Society, January 21.—Dr. Aubrey Strahan, president, in the chair.—W. R. **Watt**: Geology of the country round Huntly (Aberdeenshire). Two distinct series of rocks can be distinguished—a foliated and a non-foliated. In the former occur rocks originally sedimentary and others originally igneous. In the non-foliated series, wholly of igneous origin, three main intrusions occur:—(1) The earliest and most extensive is a norite; into this is intruded (2) the heterogeneous mass known as the Central Intrusion; and (3) the large intrusion of the Carvichen Granitite. Each of these masses produces contact-alteration in the surrounding rocks. Where the Central Intrusion or the Carvichen Granitite is intruded into the earlier norite, a norite containing cordierite is produced. The original norite, by absorption of sediment, produces also along its margin a cordierite-norite.—Dr. A. **Jowett**: The glacial geology of East Lancashire. The area comprises the western slopes of the Pennines and their westerly offshoot, the Rossendale highland. Three types of drift have been recognised:—(1) Local drift, consisting of materials which can be found *in situ* in the neighbourhood; (2) Ribblesdale drift with Carboniferous Limestone; (3) north-western drift which also contains igneous rocks from the Lake District and S.W. Scotland. The distribution of the drift and the evidence of striated rock-surfaces suggest the invasion of this area by an ice-sheet which reached up to the Pennine watershed, and projected ice-lobes across it through gaps. In the N.E. portion of the area the direction of ice-movement was from north to south; in the west from N.N.W. to S.S.E., but on the south of the Rossendale highland the direction of flow curved round towards the E.N.E., and near Rochdale, towards the north. No evidence of local glaciation has been found. The limit of the N.W. drift rises at the rate of about 4 ft. a mile towards the Irish Sea; and the ice-sheet was probably more than 2000 ft. above present sea-level in the middle of the Irish Sea in this latitude. It is probable that the N.W. ice arrived in this area later, and disappeared earlier, than the Ribblesdale ice. There is no evidence for more than one glacial period.

DUBLIN.

Royal Irish Academy, January 26.—Rev. J. P. Mahaffy, president, in the chair.—H. C. **Plummer**: Note on the use of conjugate functions in some dynamical problems. Two-dimensional problems in dynamics can be transformed into other problems by means of the equation of energy and conjugate functions of the coordinates. The general form of the transformed equations is found for relative motion and the application to some particular cases is indicated.—J. R. **Kilroe** and T. **Hallissy**: Geology in connection with the Clare Island Survey. The paper gives a general account of the rocks entering into the structure of the island, and the geographical features to which they give rise. The older Palæozoic rocks, which form the bulk of the area, have been studied in the light of recent observations on similar rocks occurring close by on the mainland. An account of the glaciation of the island is also included, and the reconstruction of its recent geological history is attempted with a view to an explanation of the many problems connected with the present distribution of the fauna and flora of the district.

PARIS.

Academy of Sciences, February 2.—M. P. Appell in the chair.—G. **Humbert**: Some remarkable numerical functions.—A. **Haller** and R. **Cornubert**: The alkylation of the *cyclo*pentanones and breaking the cyclic chain of the tetra-alkyl derivatives into α and α', by means of sodium amide. A description of the preparation and properties of mono-, di-, tri-, and tetra-methyl-*cyclo*pentanones. The last-named compound, heated with sodium amide in toluene solution for seven hours, gives the open chain amide of 2 : 2 : 5-trimethylcaproic acid.—Charles **Richet**: A new type of anaphylaxis. Dogs chloroformed for the first time never show leucocytosis, but the same animal, chloroformed a second time after an interval of nineteen days, always presents strong leucocytosis. The increase in the number of leucocytes after the second administration of chloroform is gradual, reaching a maximum in six or seven days, and there is nothing corresponding to the anaphylactic shock.—Paul **Sabatier** and M. **Murat**: The preparation by catalysis of decahydroquinoline and of decahydroquinaldine. Ten atoms of hydrogen can be added to the quinoline and quinaldine molecules by nickel catalysis, provided that the temperature of the reaction is suitably chosen and that a very active nickel is employed. The decahydroquinaldine is new, and its properties and those of some of its derivatives are given.—Georges **Charpy**: The fragility produced in iron and steel by deformation at different temperatures.—Report on a memoir by Louis Roy, entitled "On the Movement of Viscous Media and Quasi-waves."—M. H. **Parenty** was elected a correspondant for the section of mechanics in succession to M. Duhem, elected non-resident member.—The Perpetual Secretary announced the death of M. Harry Rosenbusch, correspondant for the section of mineralogy.—M. **Gambier**: Algebraic curves of constant torsion, genus not zero.—A. **Buhl**: The extensions of Stokes's formula, the Monge-Ampère equations, and analytical functions of two variables.—E. **Cartan**: The integration of certain systems of differential equations.—R. **Boulyguine**: The representation of a prime number by a series of squares.—G. **Pólya**: A question concerning integral functions.—M. de **Broglie**: The production of Röntgen-ray spectra by simple passage of the incident rays through thin sheets.—R. **Fortrat**: The simplification and regularisation of the spectral bands by the magnetic field. A discussion of a recent paper on the same subject by MM. Deslandres and Azambuja.—E. **Tassilly**: A study of the process of diazotising by the spectroscopic method. The amount of diazo-compound formed was followed by measuring the absorption and the results for aniline, orthotoluidine, and paratoluidine given graphically.—Maurice **Drapier**: The influence of shaking on the solution of copper in nitric acid. Solutions of nitric acid of strengths readily attacking copper (30 to 48 per cent.) when at rest, lose their power of dissolving the metal when rapidly rotated or shaken. As an example, a solution of 36 per cent. nitric acid which dissolved 0·397 gram of copper from a given piece of metal at rest in fifteen minutes, dissolved only 0·004 gram in the same time when the metal was rotated at 386 turns per minute.—L. **Crussard**: Limits of inflammability and the specific retardation of inflammation.—Gustave **Chauveaud**: The constitution and morphological evolution of the bodies in the vascular plants.—M. **Blaringhem**: The production of hybrids between *Triticum monococcum* and different cultivated wheats.—H. **Agulhon** and Mlle. Th. **Robert**: The action of colloidal uranium on the pyocyanic bacillus. In the presence of minute amounts of colloidal uranium the amount of pyocyanine formed by the bacillus is greatly increased.—Louis **Roule**: The larval phases and metamorphosis of fishes belonging to the family of the Nemichythydes.—Ch. **Gravier**: A new type of parasitic Crustacean from the South American Antarctic.—M. **Jay**: Remarks on the estimation of boric acid in food substances.—H. **Guillemard**: Observations on the physiological action of climate at high altitudes. Studies on the variations in the nitrogen compounds of the blood serum at high altitudes.—J. L. **Dantan**: The tendency towards the substitution of the Portuguese oyster (*Gryphea angulata*) for the native oyster (*Ostrea edulis*).—Maurice **Nicloux**: The laws of the absorption of carbon monoxide by the blood. It has been shown in the previous paper that the hæmoglobin of the blood corpuscles put in contact with mixtures of carbon monoxide and oxygen combines with the two gases in proportions defined by their respective partial pressures and governed by the law of mass action. These experiments have now been extended to living animals (dogs), and the same laws are found to be applicable. It is shown that with a given mixture of carbon monoxide and air when breathed by an animal, the carbon monoxide is fixed by the blood up to a certain limit which cannot be passed. Oxygen displaces the carbon monoxide from the blood, and pure oxygen constitutes the best treatment for carbon monoxide poisoning.—André **Mayer** and Georges **Schaeffer**: The proportion of lipoids in the tissues and the physiological activity of the cells. Thermal regulation. When the body is subjected to extremes of heat or cold variations are produced in the amounts of lipoid phosphorus in the serum.—P. A. **Dangeard**: The penetrating power of violet and ultra-violet rays through leaves.—Em. **Bourquelot** and M. **Bridel**: Ferment equilibria. Distribution and displacements in an alcoholic medium containing glucose and two glucoside-forming ferments.—Emile **Haug**: The Triassic zone of the Huveaune.—Léon **Bertrand** and Antonin **Lanquine**: The prolongation of the Bessilons sheet in the south-west of the Maritime Alps, up to the Var valley.

BOOKS RECEIVED.

Transactions of the Connecticut Academy of Arts and Sciences. Vol. xviii. A Monograph of the Terrestrial Palæozoic Arachnida of North America. By Prof. A. Petrunkevitch. Pp. 137+plates. (New Haven, Conn.: Yale University Press.)

Notes on the Blue-Green Algæ. With a Key to the Species of Oscillatoria and Phormidium. By H. Wager. Pp. 48. (London: A. Brown and Sons, Ltd.) 2*s*. 6*d*. net.

Meteorology of Australia. Commonwealth Bureau of Meteorology. The Climate and Weather of Australia. By H. A. Hunt, G. Taylor, and E. T. Quayle. Pp. 93+plates. (Melbourne: A. J. Mullett.) 5*s*.

The Philosophy of Bergson. By Hon. B. Russell, with a Reply by W. W. Carr, and a Rejoinder by Mr. Russell. Pp. 36. (Cambridge: Bowes and Bowes; London: Macmillan and Co., Ltd.) 1*s*. net.

Gipsy Coppersmiths in Liverpool and Birkenhead. By Andreas (Mui Shuko.) Pp. iv+66. (Liverpool: H. Young and Sons.) 1*s*. net.

Ministry of Finance, Egypt. Survey Department. Meteorological Report for the year 1911. Part i., Helwan Observatory. Pp. xvi+31. (Cairo: Government Press.) P.T.15.

Tychonis Brahe Dani, Opera Omnia. Edidit J. L. E. Dreyer. Tomus i. Pp. lix+320. (Copenhagen: Gyldendalske Boghandel.)

The Geographic Society of Chicago. Bulletin No. 5. Animal Communities in Temperate America as Illustrated in the Chicago Region. By Dr. V. E. Shelford. Pp. xiii+362. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press.) 12*s*. net.

A Text-book of Medical Entomology. By W. S. Patton and Dr. F. W. Cragg. Pp. xxxiv+768+lxxxix plates. (London, Madras, and Calcutta: Christian Literature Society for India.) 21*s*.

Stanford's Geological Atlas of Great Britain and Ireland. By H. B. Woodward. Third edition. Pp. xii+214+50 plates. (London: E. Stanford, Ltd.) 12*s*. 6*d*. net.

Aus Chiles Vergangenheit Plaudereien. By A. Wilckens. Pp. 108. (Valparaiso: C. F. Niemeyer.)

Year-Book of the Royal Society of London, 1914. Pp. 254. (London: Harrison and Sons.) 5*s*.

The Institute of Chemistry of Great Britain and Ireland. Lectures on the Research Chemist in the Works, with Special Reference to the Textile Industries. By W. P. Dreaper. Pp. 70. (London: Institute of Chemistry.)

Dental Diseases in Relation to Public Health. By

Dr. J. Sim Wallace. Pp. viii+90. (London: *The Dental Record.*) 3s. net.

Tabellen zur Berechnung der "theoretischen" Molrefraktionen organischer Verbindungen. By K. v. Auwers and A. Boennecke. Pp. 27. (Berlin: J. Springer.) 1.20 marks.

Die Entstehung des Lebendigen. By Prof. E. Schwalbe. Pp. 27. (Jena: G. Fischer.) 80 pfennigs.

Dynamics. By Prof. H. Lamb. Pp. xi+344. (Cambridge University Press.) 10s. 6d. net.

Kaiserliche Marine, Deutsche Seewarte. Deutsches Meteorologisches Jahrbuch für 1912. Beobachtungs-System der Deutschen Seewarte. Ergebnisse der Meteorologischen Beobachtungen. Jahrgang xxxv. Pp. vii+176. (Hamburg.)

Die Tiere der Vorwelt. By Prof. O. Abel. Pp. iv+88. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Die neueren Wärmekraftmaschinen. I., Einführung in die Theorie und den Bau der Gasmaschinen. By Prof. R. Vater. Pp. iv+120. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Leitfaden für das embryologische Praktikum und Grundriss der Entwicklungslehre des Menschen und der Wirbeltiere. By Prof. A. Oppel. Pp. vii+313. (Jena: G. Fischer.) 10 marks.

DIARY OF SOCIETIES.

THURSDAY, February 12

Royal Society, at 4.30.—Chemical Action that is Stimulated by Alternating Currents: S. G. Brown.—The Effect of the Gangetic Alluvium on the Plumb-line in Northern India: R. D. Oldham.—Note on the Origin of Black Body Radiation: G. W. Walker.—The Transmission of Electric Waves along the Earth's Surface: Prof. H. M. Macdonald.—Transparence or Translucence of the Surface Film Produced in Polishing Metals: G. T. Beilby.—A Thermomagnetic Study of the Eutectoid Transition Point of Carbon Steels: Dr S. W. J. Smith and J. Guild.—Note on Osmotic Pressure: W. R. Bousfield.

Royal Institution, at 3.—Types and Causes of Earth Crust Folds: Sir Thomas H. Holland, K.C.I.E.

Concrete Institute, at 7.30.—Factory Construction: P. M. Fraser.

Royal Society of Arts, at 4.30.—Khorasan: the Eastern Provinces of Persia: Major Percy M. Sykes.

Institution of Electrical Engineers, at 8.—Some Railway Conditions governing Electrification: R. T. Smith.

FRIDAY, February 13.

Royal Institution, at 9.—Production of Neon and Helium by Electric Discharge: Prof. J. Norman Collie.

Royal Astronomical Society, at 5.—Anniversary Meeting.

Physical Society, at 8.—The Moving Coil Ballistic Galvanometer: R. Ll. Jones.—Vibration Galvanometers of Low Effective Resistance: A. Campbell.—Vacuum-tight Lead-seals for Sealing-in-wires in Vitreous Silica and other Glasses: Dr. H. J. S. Sand.

Malacological Society, at 8.—Annual Meeting.—Presidential Address: Some Points and Problems in Geographical Distribution: Rev. A. H. Cooke.

Alchemical Society, at 8.15.—Some Notes on the Doctrine of the First Matter, with Special Reference to the Works of Thomas Vaughan: Sijil Abelul-Ali.

SATURDAY, February 14.

Royal Institution, at 3.—The Electric Emissivity of Matter. I.: The Metals: Dr. J. A. Harker.

MONDAY, February 16.

Royal Society of Arts, at 8.—Artistic Lithography: J. Pennell.

TUESDAY, February 17.

Royal Institution, at 3.—Animals and Plants under Domestication: Prof. W. Bateson.

Zoological Society, at 8.30.—Lantern Demonstration of the Helminthes collected by Scott's Antarctic Expedition: Dr. R. T. Leiper and Surgeon Atkinson, R.N.—Observations made to ascertain whether any Relation subsists between the Seasonal Assumption of the "Eclipse" Plumage in the Mallard (*Anas boscas*) and the Condition of the Testicle: C. G. Seligmann and S. G. Shattock.—Some Phases in the Female Reproductive System of the Mole (*Talpa europaea*): F. Wood Jones.—Contributions to a Study of the Dragon-fly Fauna of Borneo. II.: The Gomphinæ and Chlorogomphinæ: F. F. Laidlaw.—Note on an Imperfectly-developed Specimen of *Echinus esculentus*: H. C. Chadwick.—The Possible Connection between Spindle-length and Cell-volume: C. F. U. Meek.

Royal Geographical Society, at 8.45.—Some Aspects of Travel: Rudyard Kipling.

Royal Anthropological Institute (Joint Meeting with the Prehistoric Society of East Anglia), at 4.—Papers by Members of the Prehistoric Society of East Anglia.—At 8.15.—Flint Finds in Connection with Sand; R. A. Smith.—The Experimental Investigation of Flint Fracture and Problems of Early Man: S. Hazzledine Warren.

Illuminating Engineering Society, at 8.—Discussion on the Lighting of Picture Galleries and Art Studios: Opened by Prof. S. P. Thompson.

Institution of Civil Engineers, at 8.—*Further Discussion:* The New Harbour Works and Dockyard at Gibraltar: A. Scott.

Royal Statistical Society, at 5.—The Census of the Empire, 1911: Its Scope and some of its Results: Sir J. Athelstane Baines.

WEDNESDAY, February 18.

Aëronautical Society, at 8.30.—Aërial Navigation at Sea.

Royal Society of Arts, at 8.—The Preservation of Wood: A. J. Wallis-Taylor.

Royal Meteorological Society, at 7.30.—The Interpretation of the Results of Soundings with Pilot Balloons: Dr. W. N. Shaw.—Pilot Balloon Ascents at the Central Flying School, Upavon, during the Year 1913: G. M. B. Dobson.

THURSDAY, February 19.

Royal Society, at 4.30.—*Probable Papers:* The Brain of Primitive Man, with Special Reference to the Cranial Cast and Skull of Eoanthropus (The Piltdown Man): Prof. G. Elliot Smith.—Oxidases: Prof. A. J. Ewart.—A New Malaria Parasite of Man: Dr. J. W. W. Stephens.—Investigations Dealing with the Phenomena of "Clot" Formations. II: The Formation of a Gel from Cholate Solutions having many Properties Analogous to those of Cell Membranes: S. B. Schryver.—The Influence of the Position of the Cut upon Regeneration in *Gunda ulvae:* D. Jordan Lloyd.

Institution of Mining and Metallurgy, at 8.

FRIDAY, February 20.

Royal Institution, at 9.—Busts and Portraits of Shakespeare and of Burns: An Anthropological Study: Prof. Arthur Keith.

Institution of Mechanical Engineers, at 8.—Annual General Meeting.—Some Modern Methods of Welding; T. T. Heaton.

Institution of Civil Engineers at 8.—The Use of Reinforced Concrete in Connection with Dock and Other Maritime Work: C. S. Meik.

SATURDAY, February 21.

Royal Institution, at 3.—The Electric Emissivity of Matter: Dr. J. A. Harker.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2312, Vol. 92] THURSDAY, FEBRUARY 19, 1914 [Price Sixpence

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THURSDAY, FEBRUARY 19, 1914.

THE PRACTICAL METALLURGY OF STEEL.

Liquid Steel, its Manufacture and Cost. By David Carnegie, assisted by Sidney G. Gladwin. Pp. xxv+520+x plates. (London: Longmans, Green and Co., 1913.) Price 25*s*. net.

THE outstanding features of this valuable book are its most useful tables of the costs, both of plants and working expenses, which, as the authors point out, are approximate, being subject to the market fluctuations of material and labour. The first fifty pages of the book deal with the various materials used in steel manufacture, opening with a disconcerting table of the world's output of steel ingots. In 1910 the United States of America made about 26,000,000 tons, Germany 14,000,000, and the United Kingdom only 6,000,000 tons. The authors point out that Germany became easily the second steel-producing country of the world owing to the introduction of the basic process, a method worked out by British metallurgists. The authors, however, do not sufficiently emphasise the fact that Great Britain now holds her position in the steel world on the quality, and not upon the quantity, of her output. The materials dealt with by the authors in their opening section also include fuels, refractory materials, fluxes, and ferro-alloys.

Part i. of the book deals with the crucible process, and the authors very truly point out that for quality (in spite of various new and valuable methods of steel-making introduced from time to time) steel made by Huntsman's process has remained supreme so far as quality is concerned for more than 170 years. In a paragraph on p. 51 the authors state that for the killing of steel ingots by means of metallic aluminium "Mitis brought out his method." The reviewer suggests to the authors that the use of aluminium (originally employed for making very mild "mitis" steel castings) was discovered by Nordenfeldt and Oestberg in Sweden about 1885. Its use for killing crucible steel ingots was first elaborated in a research forming the subject of the presidential address inaugurating the formation of the Sheffield Metallurgical Society in 1891. The authors deal with the slight but important chemical changes taking place in the crucible process in a lucid and accurate manner, though the sulphur increase from 0·05 to 0·09 per cent., noted on p. 53, suggests the use of a coke very high (say 2 per cent.) in sulphur.

Part ii. deals with the Bessemer process, and here the authors do not appear to have fully realised the differences between the English Bessemer process and the Swedish Bessemer process, nor to have grasped the vital feature of Mushet's patent which made English Bessemer steel a marketable product. The essence of Mushet's contribution was to remove the dissolved FeO, which rendered Bessemer's blown metal hopelessly red-short, by the following reaction:—

$$\underset{\text{Soluble}}{FeO} + Mn = \underset{\text{Insoluble}}{MnO} + Fe.$$

Hence the insoluble MnO passed into the slag, and the de-oxidised steel forged readily. In Sweden, instead of adding metallic manganese at the end of the blow it is present to the extent of, say, 3 per cent. in the pig iron, and hence the formation and solution of FeO during the blow is prevented. With the above exceptions the acid and basic Bessemer methods and surface-blown modifications, such as those of Robert and of Tropenas and of Stock, are well described. A valuable chapter on blowing engines is included.

Pages 253 to 257 deal with the "physics" of Bessemer steel castings, an unfortunate term from a scientific point of view, since it has reference to the amounts of ferro-silicon, ferro-manganese, aluminium, &c., necessary for the production of sound steel castings. The term "additions" might well be substituted for that of "physics."

Part iii. deals with the open-hearth process, and gives a very valuable series of illustrations of the various types of furnaces employed. An equally admirable section deals with the various designs of gas producers. The consideration of the open-hearth process is concluded by a most useful set of examples of the charges, analyses, and uses of open-hearth steel, and a brief consideration of duplex methods.

Part iv. is devoted to electric steel-making by both the arc, induction, and combined methods, but it does not make a very clear differentiation between results which are obviously theoretical or estimated and those obtained in actual practice.

Part v., and last, is devoted entirely to costs, and will without doubt be of great use to works managers.

This book is written with a knowledge obviously the result of experience, and great care has been exercised in selecting information likely to be of practical importance. It may be unhesitatingly recommended as a work of standard rank.

J. O. ARNOLD.

C C

POPULAR AND SPECIAL PHYSICS.

(1) *Wireless Telegraphy and Telephony without Wires.* By C. R. Gibson. Pp. 156. (London: Seeley, Service and Co., Ltd., 1914.) Price 2*s.* net.

(2) *A Text-book of Physics.* By Dr. R. S. Willows. Pp. viii+471. (London: Edward Arnold, n.d.) Price 7*s.* 6*d.* net.

(3) *Medizinische Physik.* By Prof. Otto Fischer. Pp. xx+1120. (Leipzig: S. Hirzel, 1913.) Price 36 marks.

(4) *Principles of Thermodynamics.* By Prof. G. A. Goodenough. Second edition, revised. Pp. xiv+327. (London: Constable and Co., Ltd., 1913.) Price 14*s.* net.

(1) MR. GIBSON'S book is a brightly written account of the development of wireless telegraphy, with just sufficient broadly popular explanations to give the ordinary reader the impression that he is understanding the nature of electricity and of electric waves. The historical sketch in chap. iv., in which the early suggestions and experiments of Steinheil, Morse (1844), Lindsay (1854), Trowbridge, and Preece (1882) find their due place, is very good reading, and the account of Lodge's syntonic jars and the improvements effected by Jackson, Righi, and Popoff brings out many points on which the ordinary man's memory has become somewhat hazy. Then comes Marconi's "antenna" and earthed apparatus, which increased the effectiveness of radiotelegraphy a hundredfold, and led to its most striking triumphs. From that time forward "wireless" and "Marconi" become almost synonymous among English speakers, but the German combination of the Braun-Siemens and Slaby-Arcs systems now known as the "Telefunken" system is allowed some space, and the American systems of de Forest and Fessenden, as also the Danish Poulsen system, are briefly described. A chapter on "telephoning without wires," a chronological table, and a short glossary of terms conclude a pleasing and eminently readable volume.

(2) Dr. Willows's "Text-book of Physics" treats the elementary phenomena rather more fully than do other works of a similar kind. One would suppose it to be intended mainly for self-tuition, to judge by the numerous examples (with answers) and the rather detailed style. The ground covered is the same as that already surveyed in countless physical works, and there is not much that is new, either in subject-matter or method of treatment, though one is pleased to see Callendar and Barnes's "J" apparatus, the hot-wire ammeter, and the moving-coil galvanometer duly explained. The illustrations are good, except Fig. 134 (erecting prism), which is incorrectly drawn. There are some minor shortcomings, such as the quite incredible explanation of osmotic pressure on p. 15, but on the whole it is a thoroughly useful and creditable work, which will no doubt be widely appreciated.

(3) A special work on "Medical Physics" is necessarily of a somewhat limited scope, but eclecticism has been carried almost to an extreme in Prof. Otto Fischer's substantial volume. It resolves itself into a collection of treatises on three or four chosen subjects. The first and most voluminous of these is the work on the kinematics and kinetics of linkages, with special reference to joints. It gives graphic methods for the kinematic analysis of the empirically determined motion of a point, and methods of compounding translational and rotational velocities, demonstrates the equivalence of the most general finite displacement of a body in space with a screw motion, and reduces the kinetics of manifold linkages to the kinetics of single, rigid bodies. Many examples are given, and the mathematical treatment is reduced to its simplest terms. One cannot help wishing that this portion of the book had been published separately, as it is self-contained, and the whole work, weighing more than 4 lb., makes an unwieldy handbook. The remainder of the volume gives certain chapters of acoustics and optics. The former comprise stationary and progressive waves, sound analysis, the physics of the ear, and the voice mechanism. The optical portion is a treatise on geometrical optics, the microscope, and the polarimeter. Only twelve pages are devoted to the human eye. If it were not for the many numerical problems and examples which form the most valuable feature of this work, one would scarcely see much prospect of it successfully competing with its many rivals. In a work on medical physics, one would have expected something on the motion of liquids in elastic and capillary tubes, on osmose and dialysis, on thermometry and hygrometry, on spectroscopy, on string galvanometers, nerve currents, and cardiograms. All this is conspicuous by its absence. It is a pity to see the utility of this otherwise admirable work curtailed by such faults of publication and presentation.

(4) Prof. Goodenough's "Thermodynamics" aims primarily at laying an adequate foundation for the advanced study of heat engines. The treatment of the fundamental laws is that of Bryan, which identifies the "second law" with the law of degradation of energy, and defines entropy in terms of unavailable energy. Chapters

x. and xi. give an account of the recent experiments on saturated and superheated vapours made in the Munich laboratory, and by Marks and Davis, and new equations for the specific heat, entropy, energy, and heat content of superheated steam are deduced and published for the first time. Throttling and "wire-drawing" are treated very fully, and a concise discussion of the various types of steam turbines and refrigerating apparatus using vapour media brings this useful and eminently practical volume to a close.

THREE BOOKS ON ENTOMOLOGY.

(1) *The Entomologist's Log-Book, and Dictionary of the Life Histories and Food Plants of the British Macro-Lepidoptera.* By A. G. Scorer. Pp. vii + 374. (London: George Routledge and Sons, Ltd., 1913.) Price 7*s.* 6*d.* net.

(2) *The Fauna of British India, including Ceylon and Burma.* Edited by Dr. A. E. Shipley, assisted by Guy A. K. Marshall. *Diptera nematocera* (excluding Chironomidæ and Culicidæ). By E. Brunetti. Pp. xxix + 581 + xii plates. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co., 1912.) Price 20*s.*

(3) *Handbuch der Entomologie.* Herausgegeben von Prof. Chr. Schröder. Lieferung 1–3. Pp. iv + 480. (Jena: Gustav Fischer, 1912–13.) Price 15 marks.

(1) "THE Entomologist's Log-Book," compiled by Mr. Scorer, should be extremely useful to all those who for any reason are interested in the natural history of our British butterflies and larger moths. Not only the ordinary collector, but also the worker in bionomic problems and the economic entomologist will find here information of value in easily accessible form. The arrangement of the book is alphabetical, the names of both insects and plants occurring in their proper order, so that reference to any item that may be wanted can be found at once. Under the name of each plant is given a full list of the Macrolepidoptera that feed upon it; while as to the insects themselves, it would be difficult to adduce any well-authenticated fact of their life-history which is not duly recorded in the appropriate place. We have tested the data in several particulars, and have found them accurate and trustworthy as representing existing knowledge. There are still gaps in our information as to life-histories; many of these, it is to be hoped, will be filled up by the help of Mr. Scorer's book, the usefulness of which is enhanced by interleaving with blank pages.

(2) The names of the editors and author of the recently published volume of the "Fauna of British India," dealing with the *Diptera nematocera*, are a sufficient guarantee that the work is worthy of the admirable series to which it belongs. The study of the two-winged flies, besides its intrinsic scientific interest, derives great importance from the influence exercised by members of the order upon agriculture and forestry, and their intimate connection with various forms of disease. Mr. Brunetti's work bears the impress of much minute and careful investigation; and the sections devoted to the external anatomy, the life-history of the early stages, and the classification of the Diptera are as valuable in their way as the more distinctively systematic portion. The plates of wing-venation and other details are well executed and clear.

(3) The first three parts of the elaborate "Handbuch der Entomologie," issued under the editorship of Prof. Schröder, contain chapters by Prof. Deegener, of Berlin, on the integuments and cutaneous organs, on the nervous system and organs of sense, the alimentary tract with its appendages, the organs of respiration and circulation, the body-cavity, the musculature and endoskeleton of insects. Dr. Prochnow adds a section on stridulating and other sound-producing organs. The portion at present published, which runs to nearly 500 pages, is less than a quarter of the work as it will ultimately appear. It will be seen, therefore, that the treatise has been planned on an extensive scale. The parts now before us constitute the fullest connected account as yet available of the departments of insect morphology with which they deal. The execution of the work is for the most part good, and the figures reach a high standard of merit. The bibliography, though in places not quite complete, has evidently been compiled with great care.

In a general work of this kind, however excellent, it usually happens that the student of special points finds something to criticise. There is no exception here; the section devoted to scent-glands contains several statements that are open to question, and a figure is borrowed from Illig which purports to represent a plume-scale from *Pieris napi,* but gives a very erroneous idea of that structure. Freiling, from whom several figures are taken, though cited in the text, appears to have no place in the bibliography. But slips of this kind are rare. It is worth noting that the remarkable conclusions on pupal assimilation announced by the Gräfin von Linden (see NATURE, vol. xc., 1913, p. 379) are considered by Prof. Deegener to be unwarranted by the existing evidence.

F. A. D.

OUR BOOKSHELF.

Die radioaktive Strahlung als Gegenstand wahrscheinlichkeitstheoretischer Untersuchungen. By Prof. L. v. Bortkiewicz. Pp. 84. (Berlin: Julius Springer, 1913.) Price 4 marks.

THIS mathematical work is a critical application of the theory of chance to the breaking down of radio-active atoms. Its discussion is mainly based on the experiments of Rutherford and Geiger. Scintillations were produced on a screen by polonium, and were counted over a succession of equal short intervals of time, and the intervals were classified by the number of them which showed either no scintillation or one or two or more. The experimenters found that their numbers agreed well with those predicted by the theory of pure chance, but they gave no criterion as to the closeness of agreement to be expected. The calculation of the "mean errors" is a simple matter, but in the comparison of such a series of numbers it is only likely that in a few of the cases the mean error should be considerably exceeded. Prof. Bortkiewicz therefore provides a single test for the whole experiment. He works out twelve cases, and concludes that the results are, on the whole, slightly closer to their most probable values than is predicted by theory. He suggests an experimental cause for this small discrepancy. He also discusses one of the experiments of Marsden and Barratt, who made their analysis by classifying the lengths of time between each two successive scintillations, and he concludes that the distribution is normal. In this case his test is not perfectly satisfactory, as it involves the use of quadrature and interpolation formulæ, processes which would seem to be very unsuitable for problems of chance. In both types of experiment distributions can be contrived which pass his tests, and yet are in reality very improbable, but no doubt there are great mathematical difficulties in the way of deriving the true probability test. From his work we may conclude that the search for regularity, other than the regularity of chance, in the disintegration of radio-active atoms is not a hopeful quest.

C. G. D.

A Pocket-Book for Miners and Metallurgists: Comprising Rules, Formulæ, Tables and Notes for use in Field and Office Work. Compiled by F. D. Power. Third edition, corrected. Pp. xiv+371. (London: Crosby Lockwood and Son, 1914.) Price 6*s*. net.

MINING engineers are nowadays called upon for knowledge and powers in so many directions that to anticipate moderate success and escape serious blame, they must exhibit qualities for which Gilbert and Sullivan's heavy dragoon could not hope. To be ready to act at short notice as an explorer, a geologist, a civil and mechanical engineer, a chemist, a metallurgist, a doctor, and a lawyer, a man needs some little book in his pocket which he can consult as each new problem comes into view. Such a book Mr. Danvers Power set himself to construct many years ago, and the third edition, now issued, is not less successful than its forerunners. There is no trace of the amateur about the little volume. It is the work of a professional man who has set down the things he wanted to know himself. Like all pocket encyclopædias, it does not contain everything that could be wished for. There might have been included something about furnaces, refractory substances, and melting points, a few tips on mine-surveying problems, a little more about the strength of materials, and perhaps some information on first aid. But although there may be a few omissions, so much is included that the book deserves a trial by every prudent miner or metallurgist.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Constitution of the Interior of the Earth as Revealed by Earthquakes.

ON p. 45 of Dr. G. W. Walker's recently published book, "Modern Seismology," I find the following sentence:—"It has sometimes been asserted that S never reaches beyond a certain distance, and to explain this an impenetrable core of the earth has been assumed. We see that no such hypothesis is at all necessary to explain the observations." The reference here seems to be to a paper, by myself, "The Constitution of the Interior of the Earth as Revealed by Earthquakes," which was published in the Quarterly Journal of the Geological Society (vol. lxii., 1906), or, more probably, to the references to this paper contained in Prof. Wiechert's paper, "Ueber Erdbebenwellen," published in the *Nachrichten d. K. Gesellschaft d. Wissenschaften* (Göttingen, 1907), and as the summary dismissal of the subject indicates an imperfect appreciation of the problem, which is one of the important problems of the immediate future of seismological research, I trust you will afford me space to state the position.

In my paper, referred to above, I pointed out that the twofold character of the preliminary tremors, representing the arrival of two distinct forms of wave motion, can be traced continuously up to a distance of about 110° or 1200 km. from the origin, and that a comparison of the times of arrival of the waves at different distances shows a progressive and gradual increase of interval with distance, and affords no indication of any great change in the character of the material traversed by the wave paths. Beyond 12,000 km., however, the second phase can no longer be recognised with certainty, and has either entirely disappeared or is represented very feebly and with a considerable delay, as compared with the time of arrival which would be anticipated from the records of observations at lesser distances from the origin. From this I concluded that the wave paths to these more distant stations must have entered a central core of matter differing markedly in constitution from the outer portion of the earth, in that it was either quite incapable of transmitting the second-phase waves, or only transmitted them with a considerable diminution of energy and of rate of transmission.

Prof. Wiechert explains the facts in a different manner. From the laws of reflection, and assuming a tolerably homogeneous earth, he deduces the conclusion that waves incident on the earth's surface would suffer reflection accompanied by splitting up of the simple condensational or distortional waves into two sets, one of each kind, so that, at distant stations, the arrival of the direct waves would be complicated by the arrival of reflected waves, which had travelled one part of their course as condensational, and the other as distortional, waves. The critical point at which confusion from this cause would arise is at about 120° distant from the origin, and the disappearance of the second phase, as a recognisable feature in seismograms at greater distances, is attributed to this cause; the records, which I had accepted as possibly indicating a diminished and retarded appearance of this phase, being interpreted as the arrival of the reflected distortional waves.

With regard to this explanation, I may say that the reality of the reflected waves, though accepted by many seismologists, and practically universally by the Germans and the whole school dominated by the influence of their work, still seems to me far from being established. The theory is based on the assumption of a globe of uniform constitution bounded by a reflecting surface, but this does not exist in nature, for the outer crust of the earth is composed of material which was long ago shown, I believe first by Prof. Rudzki in 1899, to be composed of material which cannot transmit simple condensational and distortional waves, but transforms them into more complex forms of wave motion. Nor have we reason to suppose that the lower surface of this outer crust presents a definite surface of contact between two media of different character, from which reflection could take place; rather it is to be expected that the transition is gradual and that the simple forms of wave motion, which can be propagated through the central portion of the earth, would be gradually converted into more complex forms, and become extinguished, in the surface layers. On the observational side, too, the case is not conclusive, for though the presence of reflected waves in the record has been claimed, more particularly in the case of earthquakes originating in the Malay Archipelago and beyond, their presence does not seem to be constant, nor by any means so conclusively established as the reality and distinctness of the first- and second-phase waves.

Accepting, however, the reality of reflected waves and the interpretation, offered by Prof. Wiechert, of the records accepted by me, with considerable hesitation, as possibly representing the arrival of the second-phase waves, it does not afford a sufficient explanation of the absence of the record of the arrival of the second-phase waves, travelling along the direct course from the origin, in seismograms from stations at and beyond 12,000 km. from the origin. This phase is well represented, and usually conspicuous, especially in the records of horizontal pendula with a moderate rate of travel of the recording surface, and up to the limiting distance, at which it disappears, forms a feature in the seismogram which should be recognisable even if superimposed on the record of reflected waves; for, apart from the hypothesis of a central core of material less capable of transmitting these waves, there is no reason for anticipating a diminution in the amplitude of the record at greater distances, but rather the reverse.

The length of wave path of the waves emerging at the antipodes of the origin is certainly greater, about 12,750 km., as against about 9500 km. for waves emerging at 10,000 km. from the origin, but, on the other hand, two wave paths starting directly downwards with a divergence of 1° will issue on the surface at a distance of about 222 km. apart, and two wave paths starting at an inclination of about 70° to 74° downwards from the horizontal and a divergence of 1° will reach the surface at some 10,000 to 12,000 km. from the origin, and at a distance of about 500 km. apart. Setting these two against each other, we have, on one side, the increased energy due to a more than twofold concentration of wave paths, and, on the other, the greater absorption due to about 30 per cent. greater length of wave path, the former of which should more than counterbalance the latter, so that the record of the direct waves ought to be more conspicuous at greater distances than between 10,000 and 12,000 km., up to which it is easily recognisable. I have examined most of the records obtained at greater distances previous to 1906, and some of later date, but have failed to discover the second phase, and it seems reasonable to suppose that this may be explained by the wave paths to these greater distances having encountered a different form of matter which is less capable of transmitting the second-phase waves from that traversed by the wave paths which do not descend so deeply into the interior of the earth.

Though this letter has run to a considerable length, I hope you will allow me space to refer to another passage in Dr. Walker's book, on p. x. of the introduction, where he refers to a paper by me (published in *Phil Trans.*, 1900) as the first application of the well-known theory of longitudinal and transversal waves to Milne seismograms. Had Dr. Walker verified his reference he would have found that the paper has nothing to do with Milne seismograms, and that it was the first published demonstration of the *three-fold* character of the wave motion recorded at a distance from the origin, and incidentally an explanation of the failure of earlier attempts to interpret the records in terms of the two forms only, of longitudinal and transversal waves.

R. D. OLDHAM.

The Evidence for Spontaneous Generation.

IN reference to the letter of Profs. Farmer and Blackman in NATURE of February 12, it seems needful to state that only two of my tubes were opened in their presence. One of them showed, as I had predicted, bodies very closely resembling Torulæ, in large numbers. They were not, however, typical Torulæ, such as are represented in Figs. 1, 3, and 5, of my communication published in NATURE of January 22, and I am prepared to admit some doubt as to their nature. The other tube showed, as others of the same series had done, peculiar spores, which when shown together with their mycelium (as in Fig. 2) to an eminent fungologist, were said by him to belong to a mould allied to the genus Oospora. He had no doubt as to its nature; and I am certain that these moulds must have grown within the tubes after their sterilisation, in one case to the extent of producing, after sixteen months, two tufts plainly visible to the naked eye.

I am glad to learn that one of the colleagues of Profs. Farmer and Blackman is repeating my experiments, and trust he will, after a time, be able to solve their doubts.

H. CHARLTON BASTIAN.

The Athenæum, February 13.

The Wearing of Birds' Plumage—A Woman's Protest.

IT is very gratifying to find how earnestly the best papers are now taking up the cause of the various beautiful birds hitherto so cruelly and callously slaughtered for the sake of their plumage. The dealers in feathers seem to think that because they have embarked in that particular trade it must never be abolished, no matter if the most exquisite birds become extinct.

It is known that many trades have suffered severely from the advent of the motor-car. Whip-makers have scarcely anything to do. Harness-makers have also suffered, yet these trades could scarcely demand that motors should not be used because such might suffer thereby. And as the world becomes more thoughtful and humane, surely if birds are to be safe the plumassiers must go to the wall, and no great harm. There are other callings in which they must by degrees embark.

It is very strange that men do not more definitely show how very much they dislike seeing ospreys and humming-birds in women's hair or headgear. Men who are most feeling and know all about it, and keenly detest the cruelty that these ornaments involve, will sit by women at dinners and operas and not show in the slightest degree what they feel about these barbarous ornaments. After all, women only adorn themselves to please men, and if these had the courage to show how intensely they disliked, and were distressed, by these things, they would decidedly not be worn. To their intimates they could say, "How much more charming you would look with anything on your head or hat than that."

Of course, there is no denying the fact that woman is the sinner, and it seems very sad and shocking that all the trouble and misery brought upon birds with beautiful plumage is owing to the ignorance or cruelty of woman—*cherchez la femme*. Yes, alas! woman—and woman alone—is the sinner. She will not listen to the voice of her sisters who *do* know, and who so gladly would, and could, put her in the right way of looking at the matter. As she adorns herself chiefly to please men, well, let them educate her, with scorn and strong words if her vanity or stupidity leave her cold to information kindly given.

There is no supply without demand. This holds good of every commodity; and let the demand once cease, and all the endeavours of the kind-hearted lovers of the beautiful to preserve birds now so ruthlessly destroyed for no purpose but the adornment of vain and stupid women will be needless.

There is such an abundance of lovely ornaments to be had. Natural or artificial flowers, exquisite ribbons, laces, &c., and if there must be feathers, then take some which require no cruelty to procure, and which the deft fingers of most clever workers can dye and trim into things of weird beauty, almost as pretty as the real thing, for glint and twist can be added to ducks' and fowls' feathers enough to satisfy a savage. These would not only save the birds, but their feathers, being no longer required, would come into ever-increasing demand, and give work to thousands of women who are always complaining that there is nothing much left for them to do. This makes so many of them force themselves into positions which males could occupy. Every woman who takes a position a man could fill prevents one man marrying. This is an aspect of the case seldom considered by women, and would be well for them to ponder on. One is glad of *any* argument to induce women to think and to act in such a way that the horrible cruelties associated with their feathered heads may in time be a thing of the past. There is no doubt if they *knew* the shocking cruelties perpetrated to obtain such an unsuitable adornment to any kind-hearted woman's head, they would certainly not wish the *real* ospreys and humming-birds' feathers to be procured for them.

Of course, imitation feathers would be cheap—to some women an unpardonable fault. Well, when the adornment *must* be expensive, there are jewels and laces.

O. L.

Specific Heats and the Periodic Law—An Analogy from Sound.

I am much interested in Dr. H. Lewkowitsch's letter on specific heats and the periodic law, which appeared in Nature of February 12. His suggestion, based on Guldberg and Wage's "mass law," of a reconciliation between Sir James Dewar's recent low-temperature experiments and Dulong and Petit's earlier experiments on specific heats, seems to me most valuable.

I am well aware that analogies are apt to be dangerous, especially when pushed very far. Nevertheless, I am proposing to put forward the analogy from acoustics which may interest some of your readers.

The experiments on which my analogy depends are performed on an ordinary pianoforte, and as they may be repeated by anyone, I will state the directions thus:—Very gently strike a high note (say C in alt) with "loud" pedal down and the finger soon removed; change to soft pedal and notice how long the note is audible as you sit at the piano. Repeat in all particulars with a lower note (say C, two or three octaves below). It will be found that the lower note persists very much longer than does the higher note. Next repeat everything in the same way, but strike powerfully instead of gently. Notice the time during which each loud note remains loud (or audible to a friend in the next room). It will be found that there is very little difference in the duration of the two loud notes.

I think the analogy to be deduced is fairly obvious, but I will state it nevertheless.

Very soft notes arise from wires when vibrating with small amplitudes; these wires correspond to atoms at very low temperatures, for atoms under such conditions vibrate also with small amplitudes.

On the piano a definite amount of damping (produced by pedal action) curtails the amplitudes of the compared vibrating wires in a ratio which approximately is *inversely proportional* to their respective masses—*i.e.* equal damping (equal resistance to motion) has the *smaller* effect on the *more* massive wire. The results of Sir James Dewar's experiments at low temperatures are echoed *pianissimo* by these vibrating wires.

Louder notes correspond to higher temperatures; the amplitudes both of wires and of atoms are wider. In these circumstances of higher excitement, it is found on the piano that about the same amount of energy is wanted to reduce equally the loudness of light and heavy wires, while in the calorimeter it was shown by Dulong and Petit that about the same amount of energy is degraded in reducing equally the temperatures of light and heavy atoms.

Reginald G. Durrant.

The College, Marlborough, Wilts.

X-Rays and Metallic Crystals.

In Nature (August 14, 1913), and later in the *Philosophical Magazine* (October, 1913), Keene gave an account of some interesting experiments on the transmission of X-rays through rolled metal sheets. In connection with his investigation it may be of interest to record some results we have obtained in recent work on metallic crystals.

Some preliminary experiments were carried out with annealed specimens. A lump of copper, for instance, was cut in two, and one of the pieces heated up to a high temperature and then allowed to cool gradually, whilst the other piece was left untreated. Beams of X-rays were allowed to fall at almost grazing incidence on the two newly cut surfaces, and the reflected beam was examined on a photographic plate. It was found that the untreated specimen gave no definite reflection. In the case of the annealed specimen, however, spots were observed on the plate indicating that there were now present in the metal, crystals big enough to reflect quite an appreciable portion of the beam in definite directions. The same results were observed whether the surfaces were highly polished or badly tarnished.

On passing beams of X-rays through various metallic crystals, *e.g.* antimony, zinc, aluminium alloy (50 per cent. Al and 50 per cent. Cu), Laue spots were observed on the photographic plates. The spots

obtained on transmission through an antimony crystal are shown in the adjoining photograph. Owing, however, to the difficulty of procuring individual crystals of the metals, symmetrical Laue patterns have not yet been obtained. The experiments, however, show that this method of investigating metallic crystals may prove very helpful to the metallurgist.

E. A. OWEN.
G. G. BLAKE.

Teddington, February 9.

The Magneton and Planck's Constant.

THE relation between the magneton and Planck's constant is even more intimate than Dr. Allen's remarks (NATURE February 5), and his numerical illustration would suggest.

Using the notation employed by Dr. Allen, an electron (charge e, mass m) moving in a circular orbit (radius a) with angular velocity ω would have angular momentum $ma^2\omega$, and magnetic moment $\frac{1}{2}ea^2\omega$. On Dr. Bohr's hypothesis the angular momentum is related to Planck's constant h by the relation $ma^2\omega = h/2\pi$, and the magnetic moment becomes e/m $h/4\pi$, as Dr. Allen indicates.

The value of the magnetic moment per atom gram is $n\frac{e}{m}\frac{h}{4\pi}\frac{R}{k}$, where n is the number of such electrons per atom, and R and k the constants of the gas theory, so that R/k is the ratio of the atom gram to the atom.

Taking $\frac{e}{m} = 1{\cdot}772\ 10^7$

$\frac{ch}{k} = 1{\cdot}437$ (from radiation measurements)

$R = 8{\cdot}316\ 10^7$,

we have the magnetic moment per atom gram $= n\ 5617{\cdot}1$. But the magnetic moment per atom gram, as given by Weiss ("Idées Modernes sur la Constitution de la Matière," p. 334), is 1123·5, so that the number of such electrons in five atoms is equal to the number of magnetons per atom, as defined by Weiss, with the accuracy of Weiss's measurements and that of the constants above.

If instead of Bohr's hypothesis, the alternate one, that the angular momentum is equal to h/π, be employed, the five is replaced by ten. This seems to indicate that, in the magnetic materials, there is a unit of five (or ten) atoms, which has a constant number of magnetons.

The above results were stated by the writer in the discussion on radiation at the British Association, Birmingham, 1913. S. D. CHALMERS.

The Northampton Institute, Clerkenwell, E.C., February 7.

Zonal Structure in Colloids.

IF Mr. George Abbott (NATURE, January 29, p. 607) will refer to the paper by Prof. J. W. Gregory and myself on eozoonal structure in the ejected blocks of metamorphosed limestones of Monte Sommá and Vesuvius he will find that twenty years ago I explained the mechanism of zonal structure, and showed it to be of osmotic origin in that and other cases. This has been amply confirmed by further investigation into illustrations of my "osmotic theory" of metamorphism, and, although paid little attention to by my own countrymen, is amply credited by the recent publications of Liesegang and Kurd Endell.

Amongst several of my papers will be found references to concentric laminated structure in such objects as spherulites, oolites, pisolites, calculi, &c. This I would attribute to zones of chemical exhaustion or surplus, which, in the end, is very nearly related to chemical exhaustion or surplus in osmotic interchange.

H. J. JOHNSTON-LAVIS.

Beaulieu-sur-Mer (A.M.), France, February 1.

DR. JOHNSTON-LAVIS'S letter is indeed welcome; it confirms my own impression that English geologists have neglected concretionary processes. During my fifteen years of observation of the Fulwell beds no one ever suggested osmosis to me before Prof. S. Leduc. Even the authorities of the British Museum, South Kensington, whilst accepting a large number of my best specimens—some of them I cannot replace—have since repeatedly refused to give them the benefit of a modern classification, because none could be "recognised."

Few persons realise the great "experiment" made by nature at Sunderland, where there are two square miles of limestone, 130 ft. thick, associated with 70 ft. of the so-called marl beds. All the limestone shows magnificently the unique concretionary structure such as is unknown elsewhere in England, and, possibly, in the world.

The osmotic influence, or "osmotic interchange," as Prof. Johnson-Lavis calls it (Prof. Küster, of Bonn, in a recent letter to me says, "rhythmical precipitation, not osmosis") has operated in, and through, all the 130 ft. of rock, whilst the forces of crystallisation must have been subsequent and partial.

The change apparently took place after the strata had become solid enough for the formation of ordinary joints, the structure being conspicuous in starting from joints and bedding planes, whilst the pattern is very seldom seen to cross them. Pisolites and spherulites are, of course, common.

GEORGE ABBOTT.

Rusthall Park, Tunbridge Wells, February 9.

THREE BOOKS ABOUT BIRDS.[1]

(1) THE prefatorial note of Mr. Lowe's book, apparently emanating from the publishers, tells us that this is the first of two volumes, of which the object is to help those who wish to know something about the birds they see at the seaside. It does not claim to be a scientific work in the strict sense; but the author, Mr. Lowe, is a man of science and a traveller far and wide, and knows how to appeal equally to the specialist and the general reader. Though heavy in the hand and somewhat trying to the eyes, the book is undoubtedly a beautiful one, and will be most welcome to all who wish to learn something about birds of the shore. Happily, the photographs with which it abounds are all good, and far more useful and striking than those of most inland birds, of which we have long been getting rather weary. Both the birds of the sea and their haunts suit photography wonderfully well, and some of these pictures, notably the frontispiece, a flying gannet, are quite superb. There are, of course, too many of them, and the distinction between a picture-book and a book of natural history is not consistently maintained; for instance, in the excellent introductory chapter, where Mr. Lowe emphasises the fact that all our sea birds, the auks, petrels, and the kittiwake excepted, rarely wander far from the shore, the eye of the youthful reader will be distracted from the letterpress to photographs which have no direct bearing on the question. Yet it is most important, as a foundation of his knowledge, that he should learn this fact soundly, and be able to let his mind work on the hydrographical map opposite page 2.

On p. 22 we have two fragments of letterpress dealing with the general distribution of the gulls and their kind, interrupted by a picture of black-headed gulls coming to rest, and opposite it is one (occupying the whole page) of a herring-gull in a state of "suspicion." Turning over the page we find two whole pages occupied with photos, and Mr. Lowe's last unfinished sentence on p. 22 is only re-discovered, like one of his own ringed birds, on p. 26. Surely it would have been better, less distracting for old eyes as well as young minds, to print this chapter so that it might run consecutively, uninterrupted by illustrations which do not belong to it. Later in the book it becomes a positive relief to be able to read a page or two of letterpress almost free from photos; this is so in the very interesting description of the skuas, birds which do not allow even the most ardent photographer to deal with them very freely. Perhaps in the second volume it may be found possible to keep more consistently to the principle that illustrations should illustrate.

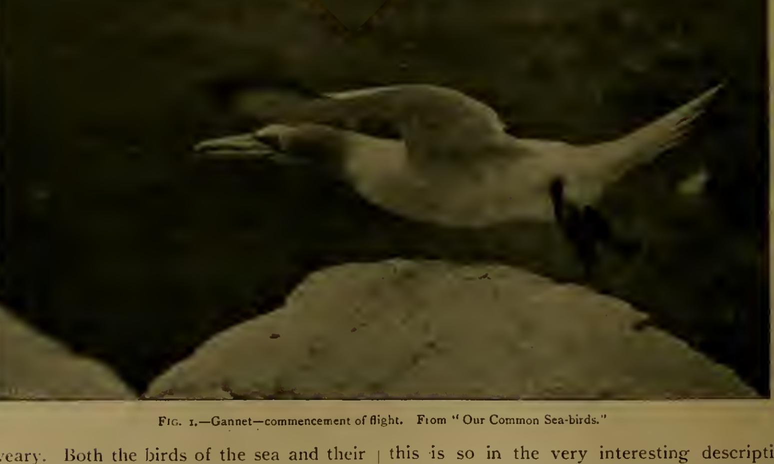

FIG. 1.—Gannet—commencement of flight. From "Our Common Sea-birds."

But we gladly allow that a great number of the photographs may be found scientifically valuable as well as artistically beautiful; for example, there is much matter here for the student of the flight of birds, especially of the gannet. And those who simply turn over the book to look at the pictures will learn much of "the life and conversation" of some thirty species, which they never could have realised (or as we say now, *visualised*) before the days of bird-photography. Lastly, as photography has brought all the writers—for there are others beside Mr. Lowe—into immediate contact with the birds they have studied for

[1] (1) "Our Common Sea-birds." By Percy R. Lowe. Pp. xvi+310. (London: *Country Life*, Ltd., n.d.) Price 15*s*. net.
(2) "Bird Life Throughout the Year." By Dr. J. H. Salter. Pp. 256+plates. (London: Headley Brothers, n.d.) Price 7*s*. 6*d*. net.
(3) "Wild Life on the Wing." By M. D. Haviland. Pp. iv+244+plates. (London: A. and C. Black, 1913.) Price 5*s*. net.

long, solitary hours in all manner of wild places, we often find vivid descriptions of their ways and movements far exceeding in interest those of pre-photographic days.

Some of the best work in the book will be found near the end, where the auks are treated of, and photos are fewer. We may specially notice Mr. Lowe's attempt to account for the "wreck" of countless little auks in February, 1912, and on other occasions, by reference to the nature of the bird's oceanic food, which might be sunk too deep for them by sudden currents of cold air reducing the temperature of the surface water; they would thus be driven before the storm in search of their usual supplies. My Pycraft a few pages further on tries to solve the mystery of the guillemot's egg, but confesses that there is no certain explanation.

FIG. 2.—Putting on the brake. From "Our Common Sea-birds."

(2) "Bird-Life throughout the Year," by Dr. J. H. Salter, is a pleasant collection of notes, some of them unusually interesting, *e.g.*, that on the nesting of the dotterel (p. 170). Dr. Salter is a real naturalist, to whom we are mainly indebted for the interest aroused in the preservation of the kite in South Wales, and his book will be a safe and stimulating guide for the young beginner. There are some good photographs in it, but the coloured ones are not always successful.

(3) "Wild Life on the Wing," by M. D. Haviland, is a collection of stories about teal, woodcock, &c., by one who is not deficient in woodcraft. Whether she is equally an adept in the art of telling a tale may be doubted; but the book is a pleasant one, and well adapted for a gift.

THE RADIATION PROBLEM.

THE radiation discussion, which was one of the most notable features of the Birmingham meeting of the British Association, appears to have created a general impression that some radical revision of our ideas as to the nature of radiation must now be regarded as unavoidable. It may therefore be of interest to give a brief summary of the present state of the problem.

Its acute phase has been brought about by the remarkable successes achieved by some forms of what is known as the "theory of quanta." This theory, or rather hypothesis, assumes that not only matter, but energy itself, has an atomistic or discontinuous structure, particularly when it is flung out into space in the form of radiant energy or radiation.

Are we, then, drifting back to a corpuscular emission theory of light, destined to replace the now generally accepted wave theory? Such a return to older views would not be altogether without precedent. History has witnessed similar fluctuations of view as regards the shape and motion of the earth, and as regards the structure of electricity. And the triumphs of atomistic conceptions in other fields, achieved with the aid of radioactivity and of Brownian motions, make the propaganda for a further extension of the atomistic principle easy. R. A. Millikan[1] maintains that the number of atoms and molecules in a given mass of matter may now be counted with as much certainty and precision as we can attain in counting the inhabitants of a city. With the characteristics of these inhabitants we can deal by means of the science of statistics, and the adherents of the new atomistic theory of radiation would have us apply statistical methods to an immense range of physical investigations.

But the hypothesis of "quanta" or irreducible and indivisible elements of energy is not merely atomism gone mad. There are certain undeniable and undoubted facts which find their simplest

[1] *Science*, vol. xxxvii., p. 119, January 24, 1913.

explanation in the hypothesis of a discrete structure of radiant energy.

Chief of these is the observed mode of transfer of energy from kathode-rays to X-rays, and *vice versâ*. Kathode rays are electrons projected with enormous velocities. The stoppage of an electron by the target in the Röntgen tube generates an X-ray pulse. All electrons are stopped within a time, which is the shorter the greater their energy of motion. Hence the X-ray pulse generated is "thin" in proportion as its energy is great. The more rapid the kathode rays, the thinner, "harder," and more penetrating are the X-rays.

Now the beautiful recent work on the reflection and interference of X-rays, often referred to in NATURE, has proved that these rays are covered by the wave-theory of light. The X-ray waves are some 10,000 times shorter than the shortest ultra-violet light waves known. They have, like ordinary light, a wave-length, or rather a range of wave-lengths, and the energy of every X-ray wave is *proportional to its frequency*, since the thinner and "harder" pulses have the smaller wave-lengths.

But this is not all. When X-rays impinge on a target, electrons are projected from it; they in turn constitute kathode rays. The velocity of these electrons is independent of the intensity of the X-ray beam. It only depends upon its "hardness," *i.e.*, its frequency, or the reciprocal of its wave-length. To put it in the language of visible light, the velocity with which an electron is expelled from the target depends, not upon the "brightness" of the X-rays, but solely upon their "colour," and is the greater the more that colour tends towards the "blue" end of the spectrum.

Moreover, those electrons which are not expelled from the material exposed to the X-rays appear to be quite unaffected, and they form the vast majority of the electrons present, unless a particular "characteristic frequency" is used for the existing rays, whereupon the electrons come out in enormous numbers.

The handing on of a quantity of energy intact from X-ray to kathode-ray and back to X-ray was used to support an atomistic view of the X-rays themselves, until it was found that the same rules apply to the liberation of electrons by ultra-violet light. Here arose a dilemma: either ultra-violet light itself (and probably all radiation) is atomic, or there is some mechanism by which radiant energy can be absorbed until a definite quantity (proportional to the frequency) is accumulated, whereupon an electron is expelled. The remarkable thing is that this energy of the electron is actually derived from the light, so that the latter does not simply liberate internal energy by some sort of "trigger" action.

All this might not have ensured a hearing for an atomistic hypothesis of energy had not Prof. Max Planck (now rector of Berlin University) put forward a theory of radiation based upon quite other considerations, which also involved an atomic structure of energy, at least when radiated.[2] He was endeavouring to explain the experimental fact that the total heat of all wave-lengths radiated by a black body (not a blackened body, but the "ideal" black represented, say, by the mouth of a deep cave) is proportional to the fourth power of its absolute temperature, and found that no formula completely representing the relation between the frequency and the amount of energy associated with it could be written down unless the energy was flung out by each molecular radiator in definite amounts or "quanta" proportional to the frequency, *i.e.*, inversely proportional to the "wave-length." This immediately accounted for the fact that, as a body gets hotter, it passes from "red" heat to "white" heat (*i.e.*, towards higher frequencies) until, when we reach the temperature of the sun, the maximum energy is well within the visible spectrum.

The actual magnitude of the supposed quanta is excessively small. For a frequency of 1 vibration per second, it would only amount to 6×10^{-27} erg, a quantity known as the "action constant." For frequencies like that of green light (600 billion per second) it would still only amount to some billionths of an erg, but such is the marvellous sensitiveness of the eye, that it can detect light (say, from a star of the sixth magnitude) when the amount of energy passing through the pupil is only some 300 or 400 quanta per second.

What, then, is the mechanism of this radiation by quanta? Are we to suppose that it resembles the sound waves proceeding from the incessant but irregular rifle fire of a large army, in which each soldier gradually accumulates sufficient powder to fire his shot? Or is it atomistic, like the bullets? Or must we fall back upon Sir J. J. Thomson's bold but rather appalling conception of a gigantic web of countless threads pervading the universe, in which each thread connects a positive and a negative electric atom, and bears its trembling message along with the speed of light in a single direction?

Whichever view may be finally adopted, we may be sure that the investigation of this fascinating problem will teach us a great deal about the interstellar æther which conveys the messages. The recent German attempt to explain away the æther, known as the electromagnetic "Principle of Relativity," has failed in its main object. Gehrcke, in his preface to Drude's "Lehrbuch der Optik," describes that principle and its temporary sway as "the most notable case of mob suggestion since the days of the N-rays." The hypothesis of quanta is saved from a similar failure by keeping in close touch with experiment. In the hands of Nernst and Lindemann and Debye it has been used with brilliant success for investigating and explaining the fall in the specific heat of all bodies as we approach the absolute zero of temperature. The specific heat probably begins by being proportional to the cube of the absolute temperature, so that the heat energy of the body is proportional to the fourth power, thus recalling the Stefan-

2 "Vorlesungen über Wärmestrahlung," 2nd edition. (Leipzig, Barth.)

Boltzmann law of total radiation already mentioned.

Planck's "action constant" has turned out a most useful quantity in all sorts of investigations, and although its actual nature is somewhat doubtful,[3] it may yet turn out to be, like the velocity of light, one of the fundamental constants of nature.

But before any quantum theory of radiant energy can be accepted, it must make its peace with those phenomena (chiefly diffraction and interference) which overthrew Newton's emission theory, and established the wave theory of light. That has not yet been done, or even attempted, so there is but little prospect as yet of a decisive battle. E. E. Fournier d'Albe.

TRANSPARENCE OR TRANSLUCENCE OF THE SURFACE FILM PRODUCED IN POLISHING METALS.[1]

In a communication to the British Association (B.A. Report, 1901, p. 604) it was suggested that all smooth metal surfaces are covered with an enamel-like transparent layer. In a subsequent communication to the Royal Society (vol. lxxii A, p. 218) the actual formation of a surface layer or skin by polishing was demonstrated. Two of the photo-micrographs in the latter paper, Figs. 5 and 6, plate 9, showed that minute pits on a polished surface of antimony had been covered over by a film of this description. It was suggested that the diminished reflecting power of the film covering the pits probably indicated that it had become translucent, but no direct evidence of this translucence was afforded by these particular observations. It was also suggested that the film might have been carried across the pits on a support provided by small granules or flakes which had filled up the pit to the level of the general surface. The purpose of the present communication is to record and illustrate certain recent observations which show:—

(1) That the film which covers the pits is transparent, or at any rate highly translucent, and

(2) That in the case of the smaller pits the mobile film has been carried across the empty pit without any support from below.

In the casting and working of copper, unless certain precautions are taken, the metal is always more or less spongy owing to the presence of gas bubbles. When the surface of this metal is ground and polished some of the gas bubbles are laid open and appear on the surface as tiny pits. If the cast metal has been subjected to cold working, by rolling or otherwise, the larger bubbles are distorted and take elongated and other varied forms.

By any method of polishing which will give a fair surface the pits are flowed over and obliterated, but by lightly etching the surface with a solvent the surface skin can be removed, and the pits are again disclosed. By careful regulation of the action of the solvent it is possible to remove the surface layer step by step, and the film covering the pits can be reduced to extreme thinness. Through this thin film one seems to be looking right into the pit. In polishing metal surfaces the amount of the metal which is removed by the polishing agent can be varied through wide limits under conditions which need not be specified here. It is sufficient for the present purpose to state that by suitable methods the skin developed on the surface may be raised to a maximum thickness or reduced to a minimum. For the present inquiry it was desirable that the film produced should be as thin as possible. The copper used in these experiments received its final polishing on fine linen stretched over a hard, flat surface, and moistened with one of the ordinary commercial brass polishing liquids. On the copper surface prepared in this way the pits, as seen under high magnification, appear as blue spots on the pale rose-coloured ground of the solid metal. While some of the film-covered pits appear uniformly blue, others show patches of red at various parts of their surface. When these red patches were first noticed it was supposed that they indicated a thickening of the film at these points to the extent necessary for normal reflection. More careful study has shown that the red patches are due to reflections from the inner concave surface of the pit. The beam of light from the vertical illuminator behind the back lens of the object glass of the microscope passes through the film covering the pit, strikes the concave metallic surface, and is reflected back through the film to the object glass and thence to the eyepiece. The reflecting surface of the pits is evidently far from optical perfection, and the reflected beam is therefore more or less broken up by irregularities of the reflecting surface.

By the use of autochrome plates it has been possible to obtain high power photo-micrographs in natural colours of pits on a copper surface. Four of these transparencies have been reproduced by the three colour process, and are shown on the plate issued as a supplement to this week's Nature. Figs. 1 and 2 are at a magnification of 800 diameters, and 3 and 4 at 1800 diameters. In Figs. 1 and 3, the pits are covered by a blue film, but show patches of red on the blue. Figs. 2 and 4 show the same pits after the film has been dissolved and removed by a 10 per cent. solution of ammonium persulphate acting for 20 to 30 seconds. On comparing the members of each pair, 1 with 2, and 3 with 4, it is seen that the red patches in 1 and 3 correspond with the spots of light reflected from the concave surfaces of the uncovered pits as shown in 2 and 4.

It is clear that the pits which show these reflections from the under surface must have been practically empty when they were covered by the film, so that the film during its flow was quite unsupported from below.

The thickness of the films covering the pits is probably of the order of 10 to 20 micromillimetres.

[3] It is an energy divided by a frequency, but has also been regarded as an angular momentum.

[1] Paper read before the Royal Society on February 12 by Dr G. T. Beilby, F.R.S.

H. B. WOODWARD F.R.S.

BY the death of Mr. Horace B. Woodward we have lost a geologist with an unrivalled experience of the stratigraphy of the British Isles. His father, Dr. S. P. Woodward, was engaged in the British Museum; and Horace, who was born in 1848, began his geological career at the age of fifteen in the employment of the Geological Society of London, as assistant in the Library and Museum. In 1867 he obtained an appointment on the Geological Survey under Sir Roderick Murchison, and continued in that department until the end of 1908. During the last seven-and-a-half years of his service he occupied the post of assistant director, and was in charge of the work in England and Wales.

In the course of this period of forty-one years Woodward did much towards developing the work of the Survey, in the direction of both precision and utility. The early surveying was carried out for the greater part of England and for all Wales on the Old Series 1-in. map. By no one were the difficulties of precise mapping on so small a scale and so obsolete a basis more successfully met than by Woodward, and it was not until his career as a member of the field-staff was drawing to a close that 6-in. ordnance maps became available. His duties lay at first in adding detail to the mapping of the Rhaetic and other secondary strata in the south-west, but later on he spent many years in Norfolk and the adjoining counties in mapping superficial deposits and the underlying Tertiary and Cretaceous strata.

Woodward was author of many valuable memoirs. The results of his early field-work are incorporated in the Geological Survey Memoirs on the East Somerset and Bristol Coalfields, on the Geology of Norwich, and the Geology of Fakenham. But the most important of his official publications were the three volumes on the Jurassic Rocks of Britain, which appeared in 1892–5. This work was the outcome of a project to bring together all that is known of each British formation. Yorkshire was otherwise provided for; but as regards the rest of the country, the heavy task of gathering all that was worth preserving from copious literature, of examining the principal sections throughout the country, and of presenting the whole in an intelligible form, was carried out single-handed by Woodward.

At this period of his official career he was temporarily engaged in Scotland in applying his knowledge of the Jurassic rocks of England to the elucidation of the occurrences in Raasay and Skye. The commercial development of the iron-ores of Raasay was due in the first place to his suggestion that there occurred there iron-ores of economic value on the same horizon as the Cleveland ores.

His more statistical memoirs, such as those on the water-supply of Lincolnshire, and of Bedfordshire with Northamptonshire, are valued as works of reference; but he showed, too, a happy facility for putting geological information into a form that was agreeable to the general reader in his account of Soils and Subsoils, and of the Geology of the London district.

Outside his official work his most important publication was the "Geology of England and Wales," first published in 1876, but revised and enlarged in 1887. An untiring industry and a wide experience of the subjects on which he was writing enabled the author to produce a work that is indispensable both to the student of the science and to those who are interested in its practical applications. No less useful in their respective subjects are his "Geology of Water-Supply," of "Soils, and Substrata," and his contributions to the Victoria County Histories.

In 1904, when the Geological Society was preparing for its centenary celebration in 1907, it was decided to prepare a volume in which the birth, development, and influence of the Society might be traced. It was felt that the writing of the historical part of such a volume could be safely entrusted to one who claimed close connection with the Society and its work for half a century.

Woodward was elected to the Geological Society in 1868, and was the recipient of the Murchison Fund in 1885, the Murchison Medal in 1897, and the Wollaston Medal in 1909. He was also one of the most active members of the Geologists' Association, and served as president in 1893–4. He was elected to the Royal Society in 1896.

His health had begun to fail at the time of his retirement from the Geological Survey, but he worked on with untiring industry until within a few hours of his death, on February 6, 1914.

COL. A. R. CLARKE, C.B., F.R.S.

IT is with more than usual regret that we record the death, on February 11, at eighty-five years of age, of Colonel Alexander Ross Clarke, one of the foremost geodesists of our time. Born in 1828, he was commissioned second lieutenant in the Corps of Royal Engineers in 1847, and was appointed to the Ordnance Survey in 1850. From this date onwards to his retirement in 1881 his energies were devoted to the work of the Survey with the exception of a three-year tour of service in Canada (1851–4). Throughout this period the work of the Ordnance Survey was in a most interesting stage, and it was fortunate that he was available to assist in the development of its scientific labours.

In 1856 Clarke took charge of the trigonometrical and levelling departments. The work of the Principal Triangulation was complete in the field, and in 1858 Clarke published the final results. The reduction of the observations by the method of least squares was in itself a laborious task, but in this volume is published in addition his first investigation into the figure of the earth.

In 1861 appeared, in two volumes, the abstracts of spirit-levelling in England and Wales, and in Scotland, for which Clarke was mainly responsible. During this year he was appointed, with two others, to meet certain French officers and draw up a scheme for connecting the triangulations of England and France. In 1862 he observed at several of the English stations of the connection, and in 1863 published the account of the completed work.

In 1860 the Russian Government invited the cooperation of the Governments of Prussia, Belgium, France, and England to cooperate in the measurement of the European longitudinal arc from Orsk to Valencia. A necessary preliminary was the intercomparison of the standards of length of the various countries affected. At the instigation of the English Government these standards were sent to Southampton, where they were compared by Clarke in a specially designed and built bar room. The result of this undertaking was published in 1866, and included in the series were 10-ft. bars for India and Australia. At the end of this volume is the second investigation which Clarke made as to the shape of the earth. In 1867 he published a pamphlet on the positions of the Feaghmain and Haverfordwest observatories, also in connection with the longitudinal arc.

In 1874 two standard yards were made for the United States of America by Messrs. Troughton and Simms, and at the express desire of the United States Government, Clarke carried out the determination of their lengths. In 1880 appeared his "Geodesy," a subject on which he had already contributed an article for the "Encyclopædia Britannica." This work has been translated into several languages.

In 1881 he retired as Lieut.-Colonel, after thirty-four years' service. Clarke's retirement was brought about by a sudden and unexpected order from the War Office to hold himself in readiness to proceed at short notice to Mauritius, and sever his connection with the Ordnance Survey. The national survey never suffered a severer loss. It took many years to recover.

The extent of the work done during those thirty-four years can only be appreciated by a study of the books he published, for they contain a mass of calculation which evidence great mathematical ability as well as great energy.

In 1883 Colonel Clarke was appointed delegate to the International Geodetic Congress in Rome in conjunction with the Astronomer Royal. In 1870 he was made a Companion of the Order of the Bath, and in 1887 he received the Royal Medal of the Royal Society, of which he was a Fellow. He was also a Fellow of the Royal Society of Edinburgh, of the Royal Astronomical Society, honorary member of the Cambridge Philosophical Society, and corresponding member of the Imperial Academy of Sciences of St. Petersburg.

Although he had for many years ceased to take an active part in the prosecution of his favourite subject, his name still remains, and will remain, a constant stimulus to a younger generation.

H. S. L. WINTERBOTHAM.

NOTES.

WE regret to announce the death on February 13, in the sixty-first year of his age, of M. Alphonse Bertillon, director of the anthropological department of the Prefecture of Police in Paris. M. Bertillon, following the custom of his family, devoted himself to the study of human races. At the beginning of his career he paid particular attention to those characters of the body which might be used for the purposes of identification. In 1885, when he was in his thirty-second year, he published the first draft of his famous system of identification and registration of criminals under the name of "Instructions signalétiques." The principle on which his system rests is that no two individuals are alike in all their bodily measurements and proportions. In 1893 Bertillon's system was introduced to British prisons. The system which, in the hands of Bertillon himself and of his pupils, worked satisfactorily, proved to be untrustworthy when applied by a heterogeneous body of observers. Even in the hands of experts, exact measurement of the living body is difficult of attainment. Hence in 1901 Bertillon's system was replaced in this country by one founded on finger imprints, a method which had been developed in India by Sir Edward Henry. It is popularly supposed that M. Bertillon invented the system of identification by finger-prints, but this is an error. Dr. Henry Faulds, in NATURE of October 28, 1880, indicated how finger-prints might be applied to ethnological classification; and his was the first printed communication upon the subject, though public and official use of finger-prints had been made by Sir William Herschel in India some years before. M. Bertillon added the finger-print method to his own about 1891, after its advantages had been urged by Sir Francis Galton. Although Bertillon's system has proved defective in practice, still the merit of realising that a scientific system of measurements and observations could be elaborated to serve the purposes of the State will always stand to his credit. Under his system an enormous number of observations of the utmost scientific value have been accumulated and placed at the disposal of anthropological students.

THE first Guthrie Lecture of the Physical Society will be delivered by Prof. R. W. Wood, of Johns Hopkins University, Baltimore, at the Imperial College of Science, on Friday, February 27. The subject of the lecture will be "Radiation of Gas Molecules Excited by Light."

WE understand from Messrs. Gurney and Jackson that Major Barrett-Hamilton's lamented death, referred to last week (p. 667), will not cause any break in the publication of his valuable work on "British Mammals," as Mr. Martin C. Hinton has agreed to continue and complete the work.

ON Saturday, February 28, Sir J. J. Thomson will begin a course of six lectures at the Royal Institution on recent discoveries in physical science. On Tuesday, March 3, Sir J. H. Biles will deliver the first of three lectures on modern ships: (1) "Smooth-water Sailing," (2) "Ocean Travel," (3) "The War

Navy"; and on Thursday, March 5, Prof. C. F. Jenkin will begin a course of three lectures on heat and cold. The Friday evening discourse on February 27 will be delivered by Prof. W. A. Bone on surface combustion.

The sea-fish hatching season at the Port Erin Biological Station has commenced earlier than usual this year, and seems to promise well. The first few hundreds of plaice eggs were found on the surface of the pond on January 28, and on February 3 embryos at least a week old were obtained. The pond was systematically skimmed for the first time on February 5, and a haul resulted of more than 200,000 fertilised plaice eggs, which are now in the hatching boxes. In recent years the first fertilised eggs have generally been obtained on some date between the middle of February and the first week of March, so the present season seems to be at least a fortnight earlier than usual.

At the anniversary meeting of the Royal Astronomical Society, held on February 13, the following officers and council were elected for the current year:—*President*, Major E. H. Hills; *Vice-Presidents*, Dr. F. W. Dyson, Dr. J. W. L. Glaisher, Prof. H. F. Newall, and Prof. H. H. Turner; *Treasurer*, Mr. E. B. Knobel; *Secretaries*, Prof. A. S. Eddington and Prof. A. Fowler; *Foreign Secretary*, Prof. Arthur Schuster; *Council*, Dr. S. Chapman, Sir W. H. M. Christie, Rev. A. L. Cortie, S.J., Dr. A. C. D. Crommelin, Mr. W. Heath, Mr. J. H. Jeans, Dr. W. H. Maw, Prof J. W. Nicholson, Rev. T. E. R. Phillips, Dr. A. A. Rambaut, Prof. R. A. Sampson, and Mr. F. J. M. Stratton.

The tenth annual meeting of the Association of American Geographers was held at Princeton at the beginning of last month. Mr. A. P. Brigham was elected president for 1914. One of the most important features of the meeting was the adoption by the association of the plan of cooperation proposed by the American Geographical Society. The plan provides for (1) a joint research committee of the two organisations to administer a joint research fund; (2) a joint meeting in New York each spring; (3) the publication by the association in collaboration with the American Geographical Society of the annals of the association; (4) an interchange of the publications of the two societies.

From numerous cuttings from the issues of the Manila Press for December 19 last which have reached us, we learn that the Bill introduced into the local Assembly, and intended to reduce the expenses of the Philippine Weather Bureau, has not been favourably received. Father Algué, the director of the bureau, who has presided over its activities for many years with conspicuous success, was given the opportunity on December 18 of laying before the Upper House, or Commission, as it is called, particulars as to the work of the bureau, and the small cost at which it is conducted. Commenting on Father Algué's statement the next day, the *Manila Daily Bulletin*, instead of supporting the suggested retrenchment, said "to the average man it should appear strange that no attempt is being made to increase the salaries of Father Algué and his entire staff at least 100 per cent."

We recently announced the issue by Messrs. Macmillan of a new publication, *Ancient Egypt*. We have since received the first number of *The Journal of Egyptian Archaeology*, issued by the Egypt Exploration Fund. The two publications, though devoted to similar subjects, are so different in matter and *format* that there is ample room for both. In the latter the article of most general interest is that by Prof. Sayce on the date of Stonehenge. He directs attention to certain beads, now in the museum at Devizes, which he identifies as Egyptian, of the period 1450–1250 B.C. Mr. H. R. Hall points out that the same identification had already been made by him in the third volume of "The Eleventh Dynasty Temple at Deir-el-Bahari" (thirty-second memoir of the Egyptian Exploration Fund). This identification is not, of course, conclusive as to the exact date of the barrow. But it corresponds fairly closely with Prof. Gowland's conclusions derived from his excavations in the course of the re-erection of a fallen pillar. The evidence would thus assign the erection of Stonehenge to the fourteenth century before our era.

We regret to announce the death on February 7, in her fifty-fourth year, of Dr. Julia Cock, consulting surgeon to the New Hospital for Women and Dean of the London (Royal Free Hospital) School of Medicine for Women. As a girl, Miss Julia Cock joined the small band of pioneer women who opened the medical profession to women. She had a distinguished career as a student, and obtained honours in her final examination. In 1887, Dr. Cock was appointed a member of the out-patient staff of the New Hospital for Women, and, in 1892, she became full physician to the hospital, round which her professional interests henceforth centred. To the end of her life she was a student, humble and eager to learn, a constant reader, untiring in her enthusiasm and devotion, an accurate observer, a magnificent clinical teacher. Dr. Cock did not value popularity, and never sought for personal recognition. She believed that "so long as good work is done, it does not matter who does it." For thirteen years she was joint lecturer in medicine at the London School of Medicine for Women. For eleven years she was dean of the school, and the high position taken by it in recent years is largely due to her administrative ability and statesmanship. She contributed valuable articles on various subjects to the literature of medical science.

The death of Prof. H. F. Rosenbusch, on January 20, 1914, at the advanced age of seventy-eight years, removes one of the most influential authors from the field of mineralogy and petrology. It is remarkable that when Zirkel published his great work on petrography in 1866, the study of thin slices of rocks under the microscope was not appreciated as an aid to research. Seven years later, Rosenbusch had no difficulty in persuading geologists of the importance of "microscopic physiography," and a band of pupils gathered at Strassburg, and later at Heidelberg, who rivalled those of Werner in carrying their master's views throughout the world. The stimulating publications of Lévy and Lacroix, working on absolutely independent lines on the other side of the Rhine, established the new methods with equal firmness; and for a time the enthusiastic study of rock-structure threatened to remove geologists from observation in the field. While Rosenbusch issued successive editions of his great work, "Die mikroskopische Physiographie der Mineralien und Gesteine," the latest being in conjunction with Dr. Wülfing in 1905–7, he also summarised admirably the characters of rocks in his "Elemente der Gesteinslehre," published in 1900. He was responsible for many changes and redefinitions in nomenclature, which have been promulgated by the weight of authority rather than by the light of reason; but the exactitude of thought and method brought by him into a subject that, since 1825, had fallen from its high estate, has earned the gratitude of petrologists in every land.

In the Transactions of the East Riding Antiquarian Society for 1912, which has recently been published, Mr. T. Sheppard contributes a valuable paper on East Yorkshire history in plan and chart. Between Bridlington and Spurn Point, a distance of some thirty miles, the land is being worn away at a rate varying from a few feet to more than 20 ft. per annum. The continuous changes in the coast-line are well illustrated by reproductions of a number of maps and charts, beginning with those of Leland and Lord Burleigh, in the time of Henry VIII., down to that by the late Mr. J. R. Boyle in 1889, showing the sites of the lost towns on the Humber.

A pamphlet by Prof. Ernst Schwalbe, entitled "Die Entstehung des Lebendigen," has just been published by Mr. Gustav Fischer, Jena. After a summary of the writings on the subject from Aristotle onwards, the author expresses the opinion that we are completely ignorant as to the origin of life, but he inclines to the view that it is supernatural.

In Lieferung 40 (pp. 1–37) of Dr. Schulze's "Das Tierreich" (Friedländer und Sohn, Berlin), Dr. G. Neumann, of Dresden, treats in considerable detail and in masterly style of the second division of the salpoid tunicates, constituting the groups Cyclomyaria and Pyrosomida. The diagrams illustrating the complex structure of these organisms seem all that could be desired, as are likewise the definitions of the various groups.

We have received a copy of *The Canadian Entomological Record* for 1912, published in the report of the Entomological Society of Ontario for that year, in which Mr. Arthur Gibson, chief assistant entomologist to the Department of Agriculture, records the most notable species of insects captured in the Dominion during the period under review, inclusive of those described as new. Another paper contributed by the entomological division of the Department of Agriculture, Ottawa—in this instance to vol. vi. of the Annals of the Entomological Society of America—records observations made by J. D. Tothill on variation in flies of the genus Lucilia. This variation embraces size, colour, and the mode of arrangement and number of the cephalic bristles. As the result of this study, it appears "that all the new characters used by Mr. Townsend for the erection of the ten supposedly distinct species are shown to come within the limits of variation of the North American species of Lucilia as recognised by Hough."

In January, 1912, Mr. C. W. Gilmore described, under the new generic and specific name of *Globidens alabamaënsis*, the remains of a mosasaurian reptile from the Upper Cretaceous of Alabama, characterised by the globular form of the cheek-teeth, that type of dentition having been previously unknown to exist in that group of lizard. By a curious coincidence, Prof. L. Dollo, of the Brussels Museum, received the imperfect remains of a lower jaw of a mosasaurian from the Maestricht Cretaceous, carrying three teeth of the same general type as those of the American specimen, but somewhat laterally compressed. He has described the Belgian specimen in *Archiv Biol.*, vol. xxviii., pp. 609–26) as a new species of the American genus under the name of *G. fraasi*. M. Dollo concludes that while the typical mosasaures (Mosasaurus) were surface swimmers, and fed on other vertebrates, the members of the genera Plioplatecarpus and Globidens were divers, the former feeding on belemnites and squids, and the latter on sea-urchins.

Many years ago the late Dr. W. T. Blanford asserted that the blackbuck (*Antilope cervicapra*) living on a spit of sand about thirty miles long between the salt Chilka Lake in Orissa, and the sea never drank water. With few exceptions, the statement was received with incredulity. That it may be practically true is, however, indicated by observations recorded by Dr. R. E. Drake-Brockman, in *The Field* of January 31 (vol. cxxiii., p. 244), relating to a herd of Pelzeln's gazelles (*Gazella pelzelni*), which have lived on the small island of Saad-ud-din, near Zeyla, Somaliland, since 1910. The usual annual rainfall is less than 3 in., and even when, as in 1911, it is considerably more, pools of water are only to be found for a few days after a heavy shower. The vegetation of the island is scanty. Dr. Drake-Brockman submits that "the result of the experiment sets at rest the question whether desert-loving antelopes can subsist without water save that which collects for a few days after a heavy shower of rain." Nothing is said with regard to the gazelles being able to obtain succulent roots or bulbs, such as those on which antelopes feed during the dry season in the Kalahari.

Under the title of *Mera Publications*, No. 1, we have received a copy of a paper by Messrs. Harold Swithinbank and G. E. Bullen on the scientific and economic aspects of the Cornish pilchard fishery, (1) "The Food and Feeding Habits of the Pilchard in Coastal Waters." In this are described some observations made on board the steam yacht *Mera* in 1913, and also certain results of inquiries made from 1905–7 off the Cornish coast. The authors conclude that the pilchard when feeding exercises some degree of selection, catching chiefly certain constituents of the zooplankton, such as copepods and larvæ of the higher crustacea, whilst other organisms, such as medusæ, are avoided. They further think that zooplankton is preferred to phytoplankton, and that there is a certain amount of evidence to show that feeding is largely undertaken at nightfall, when the surface distribution of some highly nutrient plankton species reaches a maximum. We understand that copies of the publication will be supplied free of charge to students of marine biology on application to Mr. G. E. Bullen, the Hertfordshire Museum, St. Albans.

We have received part i. of the sixth year's issue of *Der Fischerbote*, the new German fishery journal. The number is one of considerable interest. In addition to several articles on general marine biological and fishery subjects, there is the continuation of a series of accounts of the development of British fishing ports; the article in the current number deals with Fleetwood. *Der Fischerbote*, which is published fortnightly, is edited by Fishery-Director H. Lübbert and Prof. Ehrenbaum, of the Hamburg Natural History Museum.

An interesting study on heredity of skin colour in negro-white crosses is published by Dr. C. B. Davenport in No. 188 of the Publications of the Carnegie Institution (1913). The data, which include very careful observations on more than 600 individuals, were collected chiefly in Bermuda and Jamaica. The difficulties in exactly determining the grade of skin colour, and more especially in getting trustworthy information about the ancestry, are explained, and reason is given for regarding the results as generally trustworthy. It is concluded that the results obtained fit on the whole rather well with the hypothesis that the negro is homozygous for two factors for the production of black pigment, both of which are absent from the European. Since each of these factors may be present singly or in duplicate among the descendants of a cross between negro and white, there may be five conditions—none, one, two, three, or four of the factors being present. When the whole number of individuals examined is plotted in a polygon, there are, in fact, five maxima. It is concluded that the stories of the production of "black" offspring by two full whites with negro ancestry on one or both sides are mythical. There is a yellow pigment in the negro independent of the black, which may appear strongly in the paler hybrids. Eye-colour and hair-colour and form are dealt with more shortly. There is no correlation between skin-colour and hair-form, but strong correlation between skin- and hair-colour.

The Ipswich and District Field Club, in vol. iv. of its journal, includes a good colour-printed geological map of the Gipping Valley, by Mr. P. G. H. Boswell, and an account by Mr. J. Reid Moir of a workshop of Aurignacian flint implements revealed in a brickfield to the north of Ipswich. The types of implement are illustrated, and it is pointed out that hitherto remains of this stage of culture have not been found in England outside caves. Fire is believed to have been employed for fracturing the flints.

A preliminary account of the rainfall of 1913, from observations at selected stations of the British Rainfall Organisation, pending the more exhaustive examination of all available data, is published in *Symons's Meteorological Magazine* for January. The general annual fall for the whole of the British Isles was 1 per cent. below the normal; Scotland had a deficiency of 6 per cent., England and Wales one of 2 per cent., while Ireland had an excess of 5 per cent. July was the driest month, with little more than one-third of the average rainfall; August was also dry, England and Wales having exactly half the average. The wettest month was April, with a general excess of 61 per cent.; in England and Wales the excess was 80 per cent. In Scotland March was the wettest month, excess 59 per cent.; in Ireland the maximum occurred in January, excess 74 per cent. In September several rainstorms of great intensity occurred, the most notable being those at Newcastle-on-Tyne on September 16, and at Doncaster on the following day. As regards the geographical distribution the most striking feature was the deficiency in the east and the excess in the west of the country.

Those of our readers who are interested in meteorology, and have followed the recent progress in that science, will probably have noticed several important changes in the popular *Daily Weather Report* issued by the Meteorological Office. In January, 1911, arrangements were made for lithographing the report at the new office, and advantage was taken of the change to revise, *inter alia*, the arrangement of the maps. In place of the two showing pressure and temperature at 7h. a.m. of the current day, the information was combined on a single map, and the normal distribution of sea temperature was indicated by the depth of tint of the blue colour used to mark a distinction between sea and land. The area of the map then extended northwards to just beyond the Arctic circle, and included the Icelandic stations and Bodö in Norway. But from January 1 of this year an important extension has been made in the area of the principal 7h. a.m. chart, showing the observations at Vardö (extreme north of Norway), and those of the important Arctic station in Spitsbergen, while the area in the west and south is (as before) such as to allow of the inclusion of observations at Madeira and of timely wireless messages. It may be mentioned that much useful information bearing on the remarkable extensions of the telegraphic weather service in the last few years (especially since 1905) will be found in a lecture by Mr. Lempfert on British weather forecasts (Quart. Journ. R. Met. Soc., July, 1913).

Nearly half the December number of the Bulletin of the Bureau of Standards is occupied with a paper by Mr. F. W. Grover on the methods available for determining the terms of a Fourier series to represent any periodic function, such as an alternating-current wave. The method finally adopted is that given by Runge in 1903, and complete descriptions of the methods of calculation and schedules for carrying it out rapidly are given. The author hopes by this means to enable electrical engineers to undertake the necessary analysis of the curves with which they deal without too much time having to be spent in the work.

Some of the scientific and technical periodicals of Germany are beginning to use the symbols agreed on by the International Committee on units and symbols, and it may be useful to mention here some of the symbols adopted. Length l, mass m, time t, radius, r, volume V, velocity v, gravitational acceleration g, pressure p, temperature absolute T or θ, ordinary t, quantity of heat Q, specific heat at constant pressure c_p, at constant volume c_v, coefficient of linear expansion α, wave-length λ, intensity of magnetisation, $\mathfrak{J}$, magnetic field $\mathfrak{H}$, magnetic induction $\mathfrak{B}$, permeability μ susceptibility χ, electric current I, resistance R, electromotive force E, capacity C, quantity of electricity Q, self-inductance L.

The Institution of Electrical Engineers has issued a programme of the meetings to be held by its local sections until the end of May next. The seven sections are:—Birmingham, holding its meetings at the University there; Dublin, holding its meetings at the Royal College of Science; Manchester, meeting at the physical laboratory of the University; Newcastle, which, in addition to the meetings at the Armstrong College of Science, has arranged also three meetings at Middlesbrough; the Scottish, with meetings at Edinburgh and Glasgow; the Western, with meetings at Bristol and Cardiff; and the Yorkshire Local Section, meeting at the Philosophical Hall, Leeds.

In connection with wave-length and other measurements in wireless telegraphy, adjustable condensers are frequently employed, and in many cases the quantity to be measured varies with the square of the capacity of the condenser. For such purposes, therefore, an adjustable condenser following a square law should be useful, and Mr. W. Duddell, in a short paper in the Journal of the Institution of Electrical Engineers for February 2, describes the method he has used for working out the correct curve to give to the plates of a rotating sector condenser, with this object in view. The data obtained may save other experimenters from going through the work a second time.

The British Fire Prevention Committee have found it necessary to formulate a standard test and a model specification for portable chemical fire extinguishers owing to the fact that several fatalities have occurred through these appliances bursting when being operated. There is at the present moment an unfortunate tendency to put various types of "cheap-jack" appliances on the market, and the committee direct attention to the reprehensible method which is frequently adopted by makers or their agents in country towns and villages of making use of faked demonstration tests to sell such appliances. The specification can be obtained from the offices of the committee, 8 Waterloo Place, Pall Mall, S.W.

No. 13 of the Technologic Papers of the Bureau of Standards of the Department of Commerce of the United States deals with the question of electrolysis in concrete, and is an experimental investigation of the problem by Messrs. E. B. Rosa, Burton McCollum, and O. S. Peters. The report is illustrated by numerous photographs and tables of data, and fills 136 pages. Of the numerous theories that have been advanced to account for the cracking of reinforced concrete that one which attributes it to the oxidation of the iron anode following electrolytic corrosion has been fully established. The oxides formed occupy a volume which is 2·2 times as great as the original iron, and the pressure resulting from this causes the block to crack open. Many points of great interest to the architect and engineer are dealt with in full detail in the report.

Hitherto aëroplane problems have received very little attention from workers in pure science, and it is not so very long ago that an attempt by Prof. Herbert Chatley to investigate mathematically the stresses in the various parts of an aëroplane met with a very discouraging reception. We have now received a paper by Prof. H. Reissner on the strength of flying machines, published in the *Jahrbuch der wissenschaftlichen Gesellschaft für Flugtechnik*, vol. i., dealing with the general principles involved in the study of aëroplane stresses. As the author points out, the increasing use of aëroplanes in all kinds of weather, often driven at high speeds for racing purposes carrying heavier loads, and subjected to vibration for extended periods, has brought this question of safety into greatly increased prominence. Among various methods of testing strength, one consists in suspending the machine in an inverted position and loading its supporting surfaces with sand. Prof. Reissner advocates experiments in which aëroplanes are strained to the breaking point, although the cost of such tests would preclude them from being made except when a large number of machines of a particular type are being built. At the present time all aëroplanes have some of their parts strained beyond the elastic limits of the materials, a circumstance which greatly increases the difficulty of the problem.

Mr. Sijil Abdul-Ali dealt with the doctrine of the first matter as held by the alchemists, and particularly by Thomas Vaughan, in a paper read before the Alchemical Society on February 13. He pointed out that the alchemical quest was of a different nature from that pursued by the experimental chemist, and needed a different mental point of view for its appreciation. Alchemy, he said, had a secret tradition, and, in that light, a scriptural faith; it started with a theory of creation and a psychic doctrine, a symbolic presentation of which it sought in a chemical experiment. The lecture was mainly concerned with the doctrinal implications of this "first matter," and their significance for modern philosophy.

The sixteenth technological paper from the Bureau of Standards (Washington) deals with the manufacture of lime. It describes an attempt to study the effects of various impurities on the properties of lime, and to compare the efficiency of various types of manufacturing processes used in the transformation of limestone into slaked- and quick-lime. The brochure is a particularly interesting contribution to the literature of that neglected industry—lime burning; the pamphlet is of equal interest to the consumers—architects and builders—since they seek the best possible mortar, &c., for building purposes. The quality of the mortar is not only dependent upon efficient burning, but also on skilful slaking and proper mixing. The deterioration in the quality of quick- and slaked-lime with keeping also receives attention.

Another of Prof. H. B. Baker's interesting studies of the properties of purified substances is described in a recent issue of the Chemical Society's Journal, vol. ciii., p. 2060, in a paper published jointly with Mr. L. H. Parker. Two years ago, at a meeting of the Faraday Society, an experiment was shown in which water prepared under special conditions acted much more slowly than ordinary distilled water on sodium amalgam. It was remarkable that this difference persisted even after a considerable amount of caustic soda had been formed; it was therefore not due to the non-conducting properties of the special water, and has now been traced to the "catalytic action" of traces of hydrogen peroxide. These are present in ordinary samples of water, and in water prepared from pure hydrogen and oxygen in presence of palladium, but are destroyed by distilling from metallic vessels and superheating the steam. One sample of water prepared in this way in a platinum apparatus had no perceptible action on sodium amalgam in three hours, and liberated only 0·1 c.c. in four hours, 0·4 c.c. in five hours, and 0·6 c.c. in six hours. On the other hand, the addition of one part of hydrogen peroxide to 100,000 parts of another sample of water increased the amount of hydrogen liberated from 0 to 3·8 c.c. in one hour, and 4·1 to 32·4 c.c. in three hours, although it did not appreciably affect the conductivity of the water.

A catalogue of periodicals and publications of literary and scientific societies, including standard sets and library editions, which they have on sale, has been published by Messrs. W. Heffer and Sons, Ltd. An inspection of the catalogue suggests that men of science and librarians have here a good opportunity of completing their sets of transactions and of making additions to their libraries at a moderate cost.

A copy has been received from Cairo of the almanac for the year 1914 compiled in the Government Publications Office for the Egyptian Government. The object of the almanac is to furnish information likely to be useful to the various Government administrations in their relations with each other and also to the general public. In the section concerned with the Ministry of Finance, full particulars are given in connection with the Survey Department; details as to schools and colleges are included under the heading, Ministry of Education; and an exhaustive section, entitled "General Information," supplies up-to-date facts as to rainfall and other meteorological data, magnetic values, scientific societies, weights and measures, in addition to other matters of importance.

OUR ASTRONOMICAL COLUMN.

Detonating Fireball of January 19.—A considerable number of records of this object have now been received by Mr. W. F. Denning, and it is certain that the fireball descended to within a very small distance of the earth's surface, if indeed it did not actually fall to the ground. The observations are not sufficiently exact to indicate the precise spot where the meteor fell, if it came to earth, and the event might easily pass unnoticed if it occurred in a country place where no one happened to be near enough actually to witness it.

Several observers carefully timed the interval between the meteor's brilliant flash and explosion and the sound which followed. This was half a minute near Oxford and one minute a little further off in the same part, while at several other places the times are given as one minute to five minutes, according to the varying distance from the scene of the disruption. One minute's interval equals a distance of about twelve miles, and as part of this was horizontal distance and not all vertical height, it is clear the fireball was only a very few miles high at the time of its final outburst.

Inquiries should be instituted in the west part of Berkshire, near Lambourn, for it is possible evidence may be obtained as to the exact locality of the fall, if it occurred. The radiant of the meteor was south of Ursa Major, either at $132^\circ + 47^\circ$, or $154^\circ + 41^\circ$ probably.

The Total Solar Eclipse of August 21 Next.—*The Observatory* for February publishes particulars of the provisional arrangements which have been made by the Joint Permanent Eclipse Committee with regard to the observations of the total solar eclipse of August 21 next. Under the auspices of the committee Prof. Fowler, Mr. W. E. Curtis, and Father Cortie, with Major Hills and Father O'Connor as volunteers, will be situated at or near Kiev. The first two-named, with Major Hills, will devote their attention to photographing the spectrum of the chromosphere during the partial phases with iron arc comparisons. The other two will take photographs of the corona and its spectrum, chiefly in the region of longer wave-lengths. The Royal Observatory of Greenwich will be represented by Mr. Jones and Mr. Davidson, who will attempt large-scale photographs of the corona, and its spectrum, with special reference to the ultra-violet region; they will be stationed at Minsk. The Solar Physics Observatory of Cambridge will send a party of three, namely, Prof. Newall, Messrs. Stratton and Butler, and this will be stationed at Feodosia, in the Crimea. Their programme will include direct photographs of the corona on large and small scales, the former for studies of "arches," and the latter for extensions. The chromospheric spectrum will be attacked with a concave grating without slit, for comparison with the slit spectra of Prof. Fowler's programme. Polariscopic observations will also be made.

The Absorption of Light in Space.—An ingenious method of trying to detect the absorption of light in space is that of photographing the spectra of stars which have similar spectra, but the stars themselves should be at very different distances from the earth. The spectrum of the more distant star should exhibit a greater absorption towards the violet than that of the nearer star, if such absorption be present in space. This method was proposed by Prof. Kapteyn, and a first attempt has been made by Mr. Walter S. Adams, using the Cassegrain spectrograph of the Mount Wilson Solar Observatory; his results are printed in the current number of *The Astrophysical Journal* (January, vol. xxix., No. 1). The choice of stars was facilitated by the use of the ample material previously accumulated for line of sight work, and the pairs finally compared had spectra which were similar line for line. Stars of various spectrum types were employed, and of the twenty pairs investigated seven pairs were of class K0, two from each of B8, G5, and G6, and one from each of A0, F4, F7, G8, K2, K4, and K6. While six pairs showed no appreciable difference between the two ends of the spectrum, fourteen displayed a marked difference which is stated to be very great in some cases. In every case the star which is relatively faint at the violet end of the spectrum is the star of small proper motion. Mr. Adams points out that the evidence of this small amount of material is two slight to warrant any extended discussion on its application to the problem of the absorption of light in space.

WHO'S WHO IN ASTRONOMY.—The very excellent book, entitled "Astronomical Observations and Astronomers," and published under the auspices of the Royal Observatory of Belgium, which first appeared in the year 1907, is well known to most of the readers of this column, and no doubt has been found a very useful book of reference. The work was from the pens of the astronomers at the Royal Observatory of Belgium, and the task of collecting and arranging the information was no light one. It is now proposed to bring the contents thoroughly up to date, and with this intention circulars have been widely distributed requesting that the printed forms be filled in. These forms ask for a brief statement as to *personnel*, instruments, researches, and publications of observatories, and it is hoped that everyone will do his best to make the volume as complete as possible, and so render more light the labours of M. P. Stroobant and his co-workers.

WORK OF THE VIENNA RADIUM INSTITUTE.[1]

OF the seventeen papers before us, from the Radium Institute at Vienna, five by Drs. von Hevesy and Paneth, both of whom are well known in this country, contain notable advances in our knowledge of the chemistry of the radio-active elements. The chemical identity of the several members of a group of isotopic elements has been further put to the proof and extended to include the electro-chemical properties. An elegant application of this new phenomenon of isotopy has been made in analytical chemistry in the determination of the solubility of such excessively insoluble compounds as lead chromate, sulphide, &c. The principle of the method is to add to the common element its radio-isotope in unweighable, but intensely radio-active, amount, and to estimate the distribution of the former after any chemical operation from the experimental distribution of the latter by radio-active measurements. Thus radium D, derived from the decay of radium emanation, is added to lead before its precipitation by potassium chromate. Radium D being isotopic with lead, the ratio of the lead and radium D must remain unchanged by the precipitation. The quantity of lead in the filtrate is, of course, analytically undetectable, but the quantity of radium D is easily estimated. In this way the solubility of lead chromate in water at 25° was found to be 0·012 mg. per litre, or twelve parts in a thousand million.

Another important direction, in which these investigators are extending, is in the application of colloido-chemistry to the radio-elements. Often, as they and Godlewski in France have independently concluded, even these extremely attenuated solutions of the radio-elements behave as colloids rather than as electrolytes and their transport under the electric current is due to electrophoresis rather than to electrolysis. Polonium is the centre of interest in many of these researches, for it is a new element, in the sense that it is isotopic with no previously known one, and occupies a separate place in Mendeléeff's table, so that its properties cannot, like those of the majority, be exactly determined by proxy.

V. F. Hess describes a convenient method of determining quantities of radium by the γ-ray method, the quantity being read off by the constant deflection of an Elster-Geitel single quartz-thread electrometer, in conjunction with one of N. R. Campbell's high resistances of xylol and alcohol. A long attempt to arrange a standard measuring instrument, calibrated once for all, which would give the quantity of radium without the necessity of employing a radium standard, might have been more successful if the author had been acquainted with A. S. Russell's work on the measurement of γ rays and the necessity, if disturbances from secondary rays are to be avoided, of using lead, not brass, for the walls of the electroscope. In the same field Flamm and Mache continue the account of their attempts to measure the radium emanation quantitatively by the absolute value of the ionisation current in a guard-ring plate condenser.

Hess has continued his determinations of the penetrating radiation of the upper atmosphere by means of balloon ascents, and arrives at the startling conclusion that above 2000 metres there is a rapid increase in the intensity of the penetrating rays. At these heights the penetrating rays from the earth itself would be absolutely negligible, whilst that from the radium emanation in the air, which has its origin in the earth and is of limited life, must be, at any rate, less than at the surface. The conclusion that a great part of the penetrating radiation cannot come from the known radio-active constituents of the earth and atmosphere is one that must evoke general interest, and calls for the further radio-active exploration of the upper atmosphere.

Other papers deal with chemical decomposition produced by radium rays and ultra-violet light (Kailan), the solubility of radium emanation and other gases in liquids (Stefan Meyer and Martin Kofler), the variation in the ranges of the individual α particles through the probability variations in the number of molecules they encounter in their path (Freidmann), and the life periods of uranium and radium (Stefan Meyer). The latter research treats critically the known data from which these constants can be derived, and leads to the result that there is complete agreement among values obtained by independent methods. The most probable values for the periods of average life of radium and uranium respectively are 2500 and $7{\cdot}23 \times 10^9$ years. Incidentally, it may be pointed out, this makes the perennial problem of the origin of actinium more of a mystery than ever, for there should be no such agreement among the methods, if, as is supposed, some 8 per cent. of the uranium atoms branched off into actinium at some point before radium is arrived at. But it may still be doubted whether some of the data chosen, particularly the equilibrium ratio between radium and uranium, are not at fault.

F. S.

[1] Mitteilungen aus dem Institut für Radium-forschung, xxxviii-li i. Ueber Neuerungen und Erfahrungen an den Radium-messungen nach der γ-Strahlenmethode. By V. F. Hess (*Verh. D. Physikal. Ges.*, 1913, xv., Nr. 20).

SMOKE AND SMOKE PREVENTION.

"A BIBLIOGRAPHY of Smoke and Smoke Prevention," prepared by Mr. E. H. McClelland, has been published by the University of Pittsburg, Pa. (Bulletin 2, 1913, pp. 164; price 50 cents). The bibliography has been compiled for the use of the Melton Institute of Industrial Research, consisting of a body of scientific experts, who are about to embark on an inquiry, the nature and extent of which is set forth in the first bulletin issued by the institute ("Outline of the Smoke Investigation"). It contains an apparently complete list of publications dealing with smoke, its cause, effects, and prevention. In looking through the bibliography, we are struck by the extent and varied sources of the literature, a fact which clearly indicates that the smoke nuisance has no mere "local habitation," but possesses a widespread interest. English, American, German, and French volumes predominate, and if we were to estimate the extent of the nuisance in these countries by the number of publications England would stand easily first. Still, it is some consolation to think that we do not suffer alone. The question then arises, how long will the present state of apathy on the part of the public authority continue, and when will the limit to public endurance be reached? It is true that we have the smoke clauses of the Factory Acts; but a perusal of these will immediately dispel any faith in their efficacy. We have also local bylaws; but experience will teach the most casual observer that in most industrial centres atmospheric purification has undergone little change. Indeed, in some of the most notoriously bad localities average convictions do not exceed one a year. There is, we believe, a Bill to be introduced into the House of Commons, and promoted by a large and influential body of citizens connected with various industrial centres, which, it is hoped, will find its way to the statute-book. In the meantime, there is no question that demands more immediate and drastic treatment than the smoke problem owing to its effects on the health, cleanliness, and general comfort of the community.

ANTARCTIC PROBLEMS.[1]

The Problem of the Antarctic Andes and the Antarctic Horst.

AS the Weddell Sea will be the objective this year of no fewer than three Antarctic expeditions, some of its features as bearing on the above problem may be discussed first.

The continuity of Coat's Land, discovered by Dr. W. S. Bruce in the *Scotia* in 1904, with Prince Regent Luitpold Land, discovered by Dr. Filchner in the *Deutschland* in 1912, has still to be traced. Filchner sighted three Nunataks of dark rock rising from the inland ice to the south of "Vahsel Bucht," thereby proving indisputably the existence of land under the inland ice. The inland ice there rose gently from its shore cliff of from 25 ft. to 65 ft. high, up to more than 3000 ft. at a distance from the shore of about thirty miles. Of far greater importance is the tracing inland of the unknown coast to the south of Luitpold Land.

This is one of the greatest of the geographical problems which the Shackleton Expedition should solve. Amundsen, on his journey to the south pole in 1911, proved that the south-easterly trend of the Queen Alexandra Range, discovered by Shackleton at the Beardmore Glacier, is not maintained in the Queen Maud Ranges, but that the latter ranges bend to the right as one follows a great circle from the Beardmore Glacier to Graham Land. So far, this favours the theory of Penck that Antarctica is divided into a West and East Antarctica respectively, by a strait connecting the Ross Sea with the Weddell Sea, for the trend of the Queen Maud Ranges, if continued farther north in the western hemisphere, would carry it to Luitpold Land.

There can be little doubt that this Queen Maud Range is bounded by heavy fractures, of the order of several thousands of feet, for geological reasons which will be stated presently; and that these trend lines are, perhaps, as strongly pronounced as are any in the world. If, therefore, the ranges, to which they give origin, extend towards Luitpold Land, they are certain to be strongly marked, and should be capable of accurate delineation by the Transantarctic party of the new expedition. If, on the other hand, as seems more probable, the Queen Maud Ranges, when traced into the Weddell Quadrant, bend back towards Graham Land, and become continuous with Charcot Land and King Oscar II. Land, then Shackleton's other party, operating from his main base at the head of Weddell Sea, should be able to solve this all-important problem. With its length already proved of no fewer than 1400 miles, and its height of from 8000 to 15,000 ft, its stupendous fracture lines, involving displacements of 5000 to 6000 ft., and its profound influence on the meteorological conditions of Antarctica, and probably of the southern hemisphere, it is not the least important of the mountain ranges of the world, and certainly yields to none in its geological interest and the extreme difficulty of the problems which it presents.

At the Graham Land end of Antarctica, Arctowski, Nordenskjöld, Gunnar Andersson, Charcot, and Gourdon have proved that petrographically and tectonically the rocks are distinctly Andean. Granodiorites, and Andesitic rocks, in which zoned soda-lime felspars are characteristic, are there predominant. Boulders of gneissic rocks present in Tertiary strata at Seymour Island suggest a pre-Cambrian foundation complex at no great distance. Recently Dr. W. T. Gordon has identified well-preserved Archæocyathinæ in a large block of limestone dredged up by Dr. W. S. Bruce in the *Scotia*, from lat. 62° 10′ S., long. 41° 20′ W., from a depth of 1775 fathoms, near the South Orkney Islands, and specimens of *Pleurograptus ceratiocaris* and *discinocaris*, previously described by Pirie, from the collections by Bruce in the South Orkneys, proves the existence there of Ordovician rocks. The sedimentary rocks are largely formed of Jurassic plant-bearing strata, with one of the richest known fossil floras of that age in the southern hemisphere. In the west and central parts of Graham Land these have been strongly folded, and mostly overfolded to the east, as has been the case with the greater part of the formations developed in the South American Andes. Farther east in James Ross Island, Snow Hill, and Seymour Islands, &c., there is a gently inclined series of marine Cretaceous rocks, followed by Middle Tertiary rocks (Upper Oligocene to Older Miocene) with fossil leaves of Fagus, Araucaria, &c., a geological structure recalling that of East Patagonia and southern Argentina, as compared with the folded highlands of west Patagonia and southern Chile.

Then the zone of active or dormant volcanoes, which intermittently characterises the Andean Chain, is met with on both sides of Graham Land, in Bridgman, Paulet, and Deception Islands, on the west, and in Lindenberg, Christensen, Sarsee, and the Seal Island volcanoes on the east side. If now a comparison of the broad structural features of West Antarctica be made with those of East Antarctica in the Ross region it will be noticed that a great volcanic zone stretches along the western shore of Ross Sea from at least so far south as Mounts Erebus, Morning, and Discovery, to so far north as Cape Adare. This main volcanic zone of the Ross Sea region is crossed by lesser zones trending more or less east and west, like the Mounts Terror, Terra Nova, Erebus, and Dry Valley zone, the zone of the Balleny Islands, &c. If, however, this Ross Sea volcanic zone with the adjacent mountains be compared with the ranges and volcanic zones of West Antarctica, the fact at once becomes obvious that the ranges of the Ross area are entirely devoid of folding, and are of a block-faulted plateau type,

[1] Summary of a paper read before the Royal Geographical Society on February 9 by Prof. Edgeworth David, C.M.G., F.R.S.

whereas the lavas and tuffs of the Ross region are very distinct from those of West Antarctica, being strongly alkaline, of the nature of trachytes, phonolites, kenytes, &c., and of as distinctly Atlantic type as the West Antarctic rocks are of Pacific type.

The problem is further complicated by the fact that, meagre as it is, our knowledge of the geology of the King Edward Land area shows the eruptive rocks there, in which granodiorites are conspicuous, to be more nearly allied to Andean rocks than are those of Ross Sea. There, too, in the Ross Sea region, a vast coalfield with nearly horizontal strata sheets over all the older rocks from near the south pole itself to near Dr. Mawson's base in Adélie Land, a distance of more than 1600 miles. According to the preliminary report published in "Scott's Last Expedition," vol. ii., Mr. F. Debenham considers these Coal Measures to be of Upper Palæozoic age. Like the Coal Measures of Santa Catharina in southern Brazil and the northern Argentine, lying far to the east of the Andean fold area, they are but very little disturbed. Moreover, the structure of the mountains to the west of Ross Sea resembles in some respects that of the Falkland Islands, which again lie a little to the north-east of the Andean fold lines.

In the Falkland Islands undulating Devonian sandstones and quartzites lie with strong unconformity on a pre-Cambrian (?) crystalline complex, and are themselves succeeded by a nearly conformable group of Permo-Carboniferous strata with a well-marked glacial bed at its base which links it up at once with the Orleans glacial conglomerate of the Santa Catharina Coal Measure system. In his recent paper to this society, Mr. T. Griffith Taylor mentioned that the fossil fish-scales recently discovered by Mr. F. Debenham and himself at Granite Harbour, were considered by Dr. A. Smith Woodward to be of Devonian age, and the fossil tracks figured respectively by H. T. Ferrar from the lower Beacon Sandstone of East Antarctica, and by Nordenskjöld from the Devonian rocks of the Falkland Islands, show such a remarkable similarity to one another as to suggest that they are both of Devonian age. Now these late Palæozoic Coal Measures and Devonian rocks, more or less horizontally stratified, are far more characteristic of the outer foreland of the Andes, that is, the vast lower plateau or plain country lying to the east of the Andes, than they are of the Andes themselves. Sections are exhibited across typical portions of the Andes and their foreland massifs, together with type sections showing the probable geological structure of West as compared with East Antarctica, and a comparison is made between the structure of the Antarctic Horst with the "ice divide" on the lower plateau to the west, and that of the main divide between southern Chile and southern Patagonia, as described by H. Steffen, F. P. Moreno, and others. It is suggested very tentatively that in the Andean problem of the Antarctic a new physiographic enigma is propounded, viz.: When does a mountain range lose its identity as a definite unit, and become another range worthy of a different name?

The South American Andes are characterised and defined by both folds and faults. In West Antarctica the folds are present with the thrust directed easterly as in the Andes; the volcanic zone is present, and fractures are also present, as well as typical Andean eruptive rocks. In the Ross Sea region in the mountains along its western shore, the great fracture lines are perhaps continuous with those of Graham Land, but the Andean folding has died out, as well as the petrographical Andean province which is found rather in King Edward Land than in the mountains to the west of Ross Sea.

Provisionally it is suggested that while Arctowski's term, the "Antarctandes," may be used for the mountains of West Antarctica, some such term as the "Antarctic Horst" may be applied to the great ranges of the Victoria Quadrant. The party to be dispatched by Shackleton from his Weddell base westwards for 400 or 500 miles, which should include someone who is both an experienced geologist and physiographer, should be able to throw a flood of light on this great Andean problem.

Then, too, a great opportunity is offered by this expedition for sending a strong party from the Ross Sea base, not only to lay out depôts so far as to the head of the Beardmore Glacier to meet the Trans-Antarctic party on their arrival from over the great inland plateau, but also to collect systematically from the highly interesting Coal Measures, at the head of the Beardmore, with their associated fossil flora. The Shackleton expedition found wood, apparently allied to, if not identical with, coniferous wood, at the head of the Beardmore Glacier, and fossil rootlets in the adjacent shales suggest that the wood grew near where it is now found; and Captain Scott's party have brought back specimens of fossil plants scientifically of the utmost value from the same locality. There, too, at Buckley Island, or Nunatak, thick beds of Cambrian limestone with traces of Archæocyathinæ underlie the Coal Measures. It is difficult to imagine any spot in the world more fascinating from the point of view of geology, palæontology, and many allied sciences.

The problem of how trees, like modern forest trees, could flourish within 300 geographical miles of the south pole itself, which now for five months of the year is in almost total darkness, is one which involves the question as to whether the south pole was in late Palæozoic time in its present position, or whether, if the position of the earth's axes of rotation have remained constant throughout geological time, the continents may not have crept horizontally over considerable distances, as suggested by Sir John Murray and G. W. Lamplugh. The presence of the rich Jurassic flora at Hope Bay in Graham Land and of the Miocene flora of Beech and Araucaria at Seymour Island presents a similar problem.

Coast Survey.—The existence or not of New South Greenland, originally reported by Morell, is of importance for study by the various expeditions which should be in that vicinity this year and next year. Soundings, currents, and meteorological conditions suggest that New South Greenland really exists.

The recent fine piece of coastal survey work by Dr. Mawson and his Captain, J. K. Davis, whereby about 1300 miles of new coast have been added to the map, greatly needs to be extended, so as to join up with Lieut. Pennell's latest surveys to the east, on the Scott expedition, and also to connect westwards with Kemp Enderby Land and Coat's Land. Obviously the Andean problem cannot be finally settled until the great unknown area between Charcot Land, King Edward VII. Land, and Carmen Land is thoroughly explored and charted.

Meteorology.—R. C. Mossman has shown that Antarctica is of vast importance in controlling weather, not only in its own immediate neighbourhood, but even so far north as the subtropics of Chile. This very important result from the establishment of Dr. Bruce's Meteorological Station at the South Orkneys, and the later system of meteorological stations in the far south, instituted and maintained continuously by the enterprise and insight of the Argentine Government, is likely to be confirmed in the case also of East Antarctica. Just as ice conditions in the Weddell Sea largely control the rainfall of subtropical Chile, so it is probable that ice conditions in the Ross Sea may control some portions of Australasian rainfall. Unquestionably very important results have been obtained from the establishment of Dr. Mawson's wireless meteorological station at Macquarie Island in the sub-Antarctic. The Federal Government is so much impressed with the importance of the results that it has decided to maintain this station for a time, experimentally, at its own cost.

In the coming expeditions it will be important to get meteorological data as to the location of the chief cold pole of Antarctica, and as to whether the low-pressure area of Ross Sea ever leads to air being sucked over from the Weddell Sea region, or *vice versâ*. Both are low-pressure areas, so that, when their seas are ice-free, air obviously would stream into them normally from the high polar plateau. The trend of the dominant Sastrugi should be systematically mapped en route by all sledging expeditions. Measurements of the upper-air currents to supplement the work of G. C. Simpson, so admirably carried out on the Scott expedition, are much to be desired, as well as studies of evaporation and ablation generally in regard to precipitation. A meteorological observatory at the head of Weddell Sea should greatly enhance the value of the Argentine southern observatories.

Glaciology.—These problems are also interesting and important. The Weddell Barrier, as shown by the soundings, has, like the Ross Barrier, recently retreated at least 100 miles south of the position which it once occupied in late geological time.

It will be important to ascertain whether in the Weddell Sea, as at Gaussberg, at Adélie Land, at Termination Land, as well as in the Ross Barrier region, the ice has everywhere been recently retreating. The importance of the evidence of moss ice ("respirator ice") in the lids of crevasses, as indicating sea-water underlying barrier ice, should not be overlooked. The position of the Main Ice Divide on the south polar plateau should be carefully determined, as well as the directions and rate of movement of the inland ice and of the outlet glaciers. The origin and history of the outlet valleys—amongst the deepest in the world—which transect the Antarctic Horst, offers a most fascinating problem. Shafts of moderate depth should be sunk in the far inland snowfields to determine the crystallinity of the material.

Biological, physical, including magnetic, observations, as well as *chemical*, and particularly *oceanographical* investigations should, of course, not be neglected. In regard to oceanography, it may be suggested that not only should a general survey be made to develop the continental shelves, submarine ridges, and banks and deeper basins, but detailed surveys should be made in the neighbourhood of large floating piedmonts, so as to determine the existence or not of ice-scooped rock-hollows where such glaciers reach the sea floor, and of something like a terminal moraine where the barriers ended when at their maximum extension. Careful sets of serial temperatures should be taken at close vertical intervals in the sea around such floating glacier piedmonts and barriers at various seasons of the year. These should throw much light on the amount of annual loss, through melting at their base, that such floating barriers must undergo.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The council of the Senate has issued certain regulations relating to the directorship of the observatory. It is proposed that the director shall be appointed by the Observatory Syndicate at a stipend of 150*l*. a year. He will be expected to reside at the residence attached to the observatory, which will be free of rent, rates, and taxes. It is assumed that the director will in future, as in the past, be one of the professors of the University.

Mr. R. A. Peters has been re-elected to the Benn W. Levy studentship for one year.

The master and fellows of Sidney Sussex College have offered 50*l*. a year for five years toward the stipend of a University lecturer in forestry. The General Board of Studies is of opinion that the offer should be gratefully accepted, and that the lecturer should be appointed for a period of five years. The General Board has consented to a request from the forestry committee that it should have power to appoint Mr. H. Jackson as University teacher in Indian forestry.

DR. E. E. FOURNIER D'ALBE, assistant lecturer in physics in Birmingham University, has been appointed special lecturer in physics in the University of the Panjab, Lahore.

THE following advanced lectures, to which admission is free without ticket, are announced in the *London University Gazette*. A course of four lectures on the theory of wave-motion, with special reference to earthquake waves, will be given at the University by Prof. Horace Lamb, on Fridays, beginning on February 20 A course of four lectures on the Assouan Dam will be given at the Institution of Civil Engineers, Great George Street, Westminster. by Mr. J. S. Wilson, on Wednesdays, beginning on March 4.

IT is announced in *Science* that the General Education Board of the United States has given 150,000*l*. toward an endowment of 300,000*l*. for the medical department of Washington University, St. Louis, to create full-time teaching and research departments in medicine, surgery, and pediatrics. The conditions of the gift provide that all teachers in these departments, while free to render any medical or surgical service, must not derive therefrom any personal gain. Their entire time must be devoted to hospital work, to teaching and research, as it is believed that medical education in the past has suffered from the fact that the teachers have had to rely on private work for the greater part of their income. The General Education Board has also made conditional grants of 20,000*l*. each to Knox College, Galesburg, Ill., and to Washburn College, Topeka, Kan.

IN the issue of *Science* for January 23 last Prof. Rudolf Tombo, jun., of Columbia University, publishes another of his useful articles on American university statistics. On this occasion he deals with the registration returns for November 1 of last year of thirty of the leading universities in the United States. Prof. Tombo points out that these universities are neither the thirty largest universities in the country, nor necessarily the leading institutions. The only universities which show a decrease in the grand total attendance (including the summer courses) are Harvard, Western Reserve, and Yale, the attendance of the two institutions last named having remained practically stationary. The largest gains, including the summer attendance, but making due allowance by deduction for the summer course students who returned for instruction in the autumn, were registered by New York University (965), Illinois (944), and Columbia (927). This year twelve institutions exhibited an increase of more than 200 students in the autumn term attendance, as against eight in 1912. According to the figures for 1913, the institutions with an attendance of more than 5000 students, inclusive of the summer courses, rank as follows:—Columbia (9,929), California (7,071), Chicago (6,834), Michigan (6,008), Pennsylvania (5,968), Wisconsin (5,890), Harvard (5,627), Cornell (5,612), New York University (5,508), and Illinois (5,259). The largest number of officers is found at Columbia, where the staff of teaching and administrative officers consists of 907 members, as against 737 at Illinois, 731 at Harvard, 725 at Cornell, and 633 at Wisconsin.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 12.—Sir William Crookes, O.M., president, in the chair.—S. G. **Brown**: Chemical action that is stimulated by alternating currents. This paper describes experiments on the effects produced by passing a rapid alternating current through simple voltaic cells, the general effect being to stimulate chemical action and to cause the cells to give a greater supply of continuous current which otherwise would not be produced.—R. D. **Oldham**: The effect of the Gangetic alluvium on the plumb-line in northern India. The depression occupied by the Gangetic alluvium along the southern face of the Himalayas, as determined by geological observation, has a nearly vertical face on the north, and a floor sloping upwards in a southerly direction to the surface. The effect of the defect of mass in the Gangetic depression is calculated and shown to be capable of producing about 30″ of northerly deflection of the plumb-line at the margin of the range, a deflection which drops rapidly on either side of the margin, but more rapidly to the south than the north. At twenty to thirty miles south, the distance depending on the width of the trough, it becomes zero, and at greater distances is replaced by a southerly deflection.—G. W. **Walker**: Note on the origin of black-body radiation.—Prof. H. M. **Macdonald**: The transmission of electric waves along the earth's surface. A series is obtained which represents the magnetic force at any point on the surface when the oscillator is also on the surface; the series converges rapidly for large values of θ, and for not very large values the first term is a sufficient approximation. For small values of θ the series converges very slowly.—Dr. G. T. **Beilby**: Transparence or translucence of the surface film produced in polishing metals (see page 691).—Dr. S. W. J. **Smith** and J. **Guild**: A thermomagnetic study of the eutectoid transition point of carbon steels. The magnetic properties of steel at temperatures near the eutectoid transition point (A1) seemed to deserve further examination. Simultaneous observations of intensity of magnetisation and of temperature were made over various ranges of heating and of cooling in different magnetic fields. Nine steels containing percentages of carbon ranging between 0·1 and 1·5 were used. Each steel contained about 0·2 per cent., or less, of silicon and manganese. It was found that the temperature corresponding with the beginning of the transformation of the eutectoid during heating (Ac1) could be fixed within $\pm 1°$ C. under suitable conditions. This temperature was 735° C., and was the same for all the steels.—W. R. **Bousfield**: Note on osmotic pressure. It is shown that the assumption that the molecular interspaces of a solution are filled with vapour, which there behaves as a perfect gas, leads to the same general relation between vapour pressure and osmotic pressure as is given by thermodynamical considerations. The anomalous fact that the osmotic pressure of a decinormal sucrose solution is found to be greater at 0° C. than at 5° C. is explained by reference to the constitution of water and the effect of compression upon the ice molecules.

Physical Society, January 23.—Prof. C. H. Lees, vice-president, in the chair.—P. R. **Coursey**: Some characteristic curves and sensitiveness tests of crystal and other detectors. Experiments were described recently conducted on types of wireless detectors, and undertaken with a view of finding out whether any relation could be traced between the sensitiveness and characteristic curves of a detector. Sample curves for some common detectors are included, and show that in some cases a fairly good agreement exists between the sensitiveness curve of a detector and the second differential of its characteristic, this being most notable in stable crystal detectors, but it is evident that the flexure of the characteristic curve cannot be the only cause of the response of a detector to wireless signals, but that at least a second action must also be present, as it was observed, notably in the electrolytic detector, that the maximum ordinates on the second differential were at places where the measured sensitiveness was either zero or extremely small, showing that there are probably two actions opposing one another at this point. This action when present in other detectors is perhaps electrolytic in nature, or the received oscillations when superimposed on the direct-current boosting voltage partake of the properties of some "trigger" action. This view is supported by experiments with detectors of the tellurium-aluminium type.—W. **Duddell**: A water model of the musical electric arc.—C. R. **Darling**: Further experiments with liquid drops and globules.—James **Walker**: A note on aberration in a dispersive medium, and Airy's experiment. Lord Rayleigh's view that in the case of aberration we are concerned with the group-velocity instead of with the wave-velocity, makes it necessary to consider the experiment of Airy, in which he measured the angle of aberration with a telescope filled with water. A modification of Lord Rayleigh's explanation leads to the result that the angle of aberration thus determined corresponds to an angle $\mu^{-1}v/U$ measured in air. The same result is obtained from an analytical investigation, and a numerical calculation shows that the increase in the angle is about 1 per cent.—an amount that is probably too small to be detected.

Mineralogical Society, January 27.—Dr. A. E. H. Tutton, president, in the chair.—T. **Crook**: The genetic classification of rocks and ore deposits. The general principles of the classification of rocks were considered, the term rock including all mineral deposits. The exact nature of genetic grouping was defined. Both rocks and ore deposits fall into broad natural divisions in accordance with a geological grouping of formative agents and processes, the type being determined by the last operative agent or process that gave the rock its individuality. The two main groups are (1) endogenetic deposits, arising from internal causes, and (2) exogenetic deposits, of superficial origin, and these are subdivided in a consistent genetic manner. "Sedimentary" and "metamorphic" products cannot be regarded as constituting two independent subdivisions. A historical review of the application of genetic-geological principles to the classification of rocks and ore deposits was included.—Prof. A. F. **Rogers**: Lawsonite from the central coast ranges of California. Crystals from new localities were described; prismatic and tabular in habit and usually small, they displayed the forms 010, 001, 011, 110.—A. F. **Hallimond**: Uniaxial augite from Mull. The small, lath-shaped crystals, which seldom exceed ½ mm. in diameter, have refractive indices *o* 1·714, *e* 1·744, specific gravity, 3·44, pronounced dichroism (*o* smoky-brown, *e* pale yellow), two cleavage directions nearly at right angles, and an extinction angle of 30½° on the cleavage. A chemical analysis revealed distinct differences from ordinary diopside, and the composition approximates to that of hypersthene.—H. H. **Thomas** and W. Campbell **Smith**: Apparatus for grinding crystal plates and prisms. A gun-metal cylinder with its axis normal to a triangular brass-plate, about 5 cm. in diameter, resting on three screws, one of which has a graduated head, is movable vertically along, and rotatable about its axis, and by rotation of the graduated screw the axis of the cylinder is inclined at a known angle to the grinding lap. A crystal suitably mounted is brought by means of these two rotations into any desired position, a series of chucks of different inclinations being provided for holding it. The zero position is determined optically. A graphical method of determining the requisite rotations was described.

Zoological Society, February 3.—Sir John Rose Bradford, vice-president, in the chair.—G. A. **Boulenger**: Collections of Batrachians and reptiles made by the British Ornithologists' Union and the Wollaston Expeditions in Dutch New Guinea. Four species of Batrachians and eight species of reptiles were described as new.—Dr. F. E. **Beddard**: Further observations upon the Cestode genus Urocystidium, Beddard.

Mathematical Society, February 12.—Prof. H. F. Baker, vice-president, in the chair.—G. T. **Bennett**: Exhibition and explanation of some models illustrating kinematics.—Prof. H. M. **Macdonald**: Formulæ for the spherical harmonic $P_n^{-m}(\mu)$, when $1-\mu$ is a small quantity.—Prof. E. W. **Hobson**: The representation of the symmetrical nucleus of a linear integral equation.—Dr. W. F. **Sheppard**: Fitting of polynomials by the method of least squares (second paper).—H. **Bateman**: The differential geometry of point-transformations between two planes.—Major **McKendrick**: Studies in the theory of continuous probabilities.

Manchester.

Literary and Philosophical Society, January 27.—Mr. F. Nicholson, president, in the chair.—T. A. **Coward**: The willow titmouse in Lancashire and Cheshire. The author, after defending the subdivision of geographical races of birds into subspecies with distinctive trinomials, described how the Holarctic black-capped titmice fell naturally into two main groups, having as their types *Parus palustris* and *P. atricapillus*, L. The marsh-tit, the British representative of the first group, has long been recognised and accepted, but only within recent years has it been discovered that a British willow titmouse is referable to the *atricapillus* group. The willow-tit occurs along with the marsh-tit in many English counties, and it apparently replaces the latter bird in Scotland. It is found in both Lancashire and Cheshire, and in 1913, at any rate, nested in Cheshire. Most writers on British birds have described the typical marsh-tit, apparently in ignorance of the occurrence of both forms. Macgillivray, whose specimens were obtained in Scotland, accurately describes the willow titmouse. Both birds, however, are figured and described in the "British Bird Book," edited by F. B. Kirkman.—Dr. A. D. **Imms**: Observations on *Phromnia marginella* in India. He discussed the recorded instances of insects of the Fulgorid genus Phromnia, or Flata, bearing a close resemblance to certain flowers. One species, observed by J. W. Gregory, exists in two forms, one green and one reddish, and he (Gregory) describes the insects so grouped on a stem that the green individuals occupy the upper portion with the red individuals immediately beneath them, thus closely resembling a flowering spike with the green unopened buds above. On the occasions on which the author observed *P. marginella*, in the Himalayan foothills of Kumaon, the two types—one green, the other pinkish-buff—were closely intermixed. Poulton suggests that the first specimens of a group to emerge are red, and those that issue later green. Gregory may have come across undisturbed groups which, therefore, had the green specimens above and the red ones below. The groups noted by other observers may have reassembled, and thus lost the possible arrangement possessed on emergence from the pupæ. Long waxy filaments, closely related chemically to Chinese white wax, issue from the hinder extremity of the larva of *P. marginella*.

Dublin.

Royal Dublin Society, January 27.—Prof. J. Joly, in the chair.—Prof. W. **Brown** and J. **Smith**: Subsidence of torsional oscillations in nickel wires when subjected to the influence of alternating magnetic fields. The experiments showed that a remarkable decrease takes place in the internal friction of the wire when under the influence of alternating magnetic fields, the influence being more marked the higher the frequency of the alternations. There was shown also a very marked difference in the behaviour of the nickel wires in the hard and soft states, the hard wire after being subjected to an alternating magnetic field of high frequency, say 100 to 140 a second, became temporarily non-magnetic, which the authors call magnetic fatigue. That this fatigue is temporary is shown by the fact that it can be cured in several ways.—Prof. T. **Johnson**: The fouling of a water supply by Oscillatoria and its purification. In the spring of 1913, when the London water supply was contaminated by the two diatoms Asterionella and Tabellaria, an important water supply in Ireland also suffered from the presence of a Myxophycean, *Oscillatoria tenuis*, Ag., var. *natans*, which gave the storage water (360 million gallons) a fishy, mouldy smell. The water was cleared of the weed without injury to fish or man by treating it with copper sulphate (1 to 10 lb. in 1,000,000 gallons of water), as recommended by Moore and Kellerman, of the U.S. Department of Agriculture. Mud dredged from the shallow bottom of the upper end of the storage mountain lake gave the "water-bloom" of writers on examination in the laboratory.—Prof. H. H. **Dixon**: Note on changes in the sap caused by the heating of a branch. The changes which might be anticipated in the sap of the conducting tracts of a branch by the rendering permeable of the plasmatic membranes of the adjoining cells and the consequent discharge of their contents may be experimentally demonstrated by cryoscopic and conductivity measurements, and by various chemical tests. It is found that sap centrifuged from a heated branch is from four to six times more concentrated than that similarly extracted from a living one. This change in concentration of substances not rapidly absorbed would act as a physical poison on the cells of the leaves supported by the branch, and would alone explain the changes observed in these leaves. It was also found, in four cases out of five, that the sap of a steamed branch acted as a protoplasmic poison to the cells of Elodea leaves, while during the same time the sap from fresh branches was innocuous.—Prof. H. H. **Dixon**: Note on the tensile strength of the sap of trees. It has recently been stated that while water sensibly free from dissolved air has considerable tensile strength, it has been impossible to demonstrate this cohesion in the sap of trees. This statement is negatived by previous experimental work. However, it seemed of interest to test the tensile strength of sap directly. Experiments were carried out on sap centrifuged from the branches of trees. Berthelot's method of generating tension was used, but allowance was made for the distortion of the containing tube during the experiment. It was found easy to generate tension in both boiled and unboiled sap. In both cases the sap was almost, if not quite, saturated with dissolved air. The highest tension obtained with the boiled sap was 72·5 atmospheres, but with the unboiled 208 atmospheres was obtained.—Prof. J. **Joly**:

A deep-sea hydraulic engine. This engine is for developing power in depths from 200 fathoms downwards, for the purpose of boring into the deep-sea deposits. The water at the great pressure prevailing is the working substance, and after actuating the boring engine, is discharged into steel bottles which are coupled to the engine by high pressure tubing. The power available is very considerable. A full description of the entire machine, and of the methods of lowering, controlling, and raising it, were given, and working drawings were shown.

CALCUTTA.

Asiatic Society of Bengal, January 7.—Gouripati **Chatterji**: A demonstration apparatus for determining Young's modulus. An optical lever method is described, simplified so that measurements of the modulus can be made to 5 per cent. in about ten minutes for lecture demonstration purposes.—M. S. **Ramaswami**: A new species of Diospyros from the Tinnevelly Hills. A description of a hitherto undescribed Indian species of the genus Diospyros is presented.—M. S. **Ramaswami**: Studies on the leaf structure of *Zoysia pungens*, Willd. A detailed discussion of the structural adaptations, noticeable in the leaf of the maritime sandgrass *Zoysia pungens*, Willd., due to its peculiar habitat.—J. Coggin **Brown**: Grooved stone hammers from Assam and the distribution of similar forms in eastern Asia. An account of certain hammer stones with well-marked grooves or belts, from the Tezpur district, Assam. Such forms are of the greatest rarity among the numerous Neolithic stone implements in which certain parts of the Indian Empire abound. Grooved stone hammers only occur sporadically in eastern Asia, and the short list of recorded instances is given for comparison. On the other hand, they abound in the North American culture area, and are generally distributed throughout the United States. The subject is of some importance for the additional light it throws on the relation of the prehistoric archæological types of the eastern Asian and North American culture areas. It is concluded that there is no evidence to prove that the stone axe did not revolve as an independent unit in the latter area.—H. H. **Mann** and S. R. **Paranjpye**: Intermittent springs at Rajapur in the Bombay Presidency. These springs flow at very irregular intervals, generally for a month or two at a time, and are held in great veneration in western India. In this paper they are fully described and figured, their traditional history and the folklore connected with them are set forth, and partial analyses, showing that the water does not differ materially in composition from that of other springs in the Deccan Trap area, are given.

BOOKS RECEIVED.

Les Récents Progrès du Système Métrique. By C. E. Guillaume. Pp. 118. (Paris: Gauthier-Villars.) 5 francs.

Foods and Household Management: By H. Kinne and A. M. Cooley. Pp. xv+401. (London: Macmillan and Co., Ltd.) 5*s*. net.

A History of Education in Modern Times. By Prof. F. P. Graves. Pp. xv+410. (London: Macmillan and Co., Ltd.) 5*s*. net.

The Continents and their People. South America. By J. F. and A. H. Chamberlain. Pp. viii+189. (London: Macmillan and Co., Ltd.) 3*s*.

Die Süsswasser-Flora Deutschlands, Oesterreichs und der Schweiz. Edited by Prof. A. Pascher. Heft. i. Flagellatæ 1. By E. Lemmermann. Pp. iv+138. (Jena: G. Fischer.) 3.50 marks.

Elementary Commercial Geography. By Dr. H. R. Mill. Revised by F. Allen. Pp. xii+215. (Cambridge University Press.) 1*s*. 6*d*. net.

Konstitution und Vererbung in ihren Beziehungen zur Pathologie. By Prof. F. Martius. Pp viii+258. (Berlin: J. Springer.) 12 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 40 Lief. (Jena: G. Fischer.) 5 marks.

Commission Polaire Internationale. Procès-Verbal de la Session Tenue à Rome en 1913. Pp. 293. (Bruxelles: Hayez.)

Handbuch für biologische Uebungen. Zoologischer Teil. By Prof. P. Röseler and H. Lamprecht. Pp. xii+574. (Berlin: J. Springer.) 27 marks.

Catalogue of the Ungulate Mammals in the British Museum (Natural History). Vol. ii. By R. Lydekker, assisted by G. Blaine. Pp. xvi+295. (London: British Museum (Natural History); Longmans and Co.) 7*s*. 6*d*.

The Anthropology of the Greeks. By E. E. Sikes. Pp. xi+112. (London: D. Nutt.) 5*s*. net.

Physical Chemistry and Scientific Thought. By Prof. W. C. McC. Lewis. Pp. 20. (Liverpool University Press.) 1*s*. net.

Smithsonian Institution. U.S. National Museum. Bulletin 71. A Monograph of the Foraminifera of the North Pacific Ocean. By J. A. Cushman. Part iii. Lagenidæ. Pp. ix+125+47 plates. (Washington: Government Printing Office.)

Report of the Secretary of the Smithsonian Institution for the Year Ending June 30, 1913. Pp. 119. (Washington: Government Printing Office.)

Annual Report of the Director of the Weather Bureau for the Year 1910. Part iii. Pp. 268. (Manila: Bureau of Printing.)

Intermediate Mechanics for Indian Students. By F. C. Turner and Prof. J. M. Bose. Pp. xii+332. (London: Longmans and Co.) 4*s*. 6*d*.

Monistische Bausteine. By E. Haeckel. Edited by W. Breitenbach. Erstes Heft. Pp. vii+224. (Brackwede i.W.: Dr. W. Breitenbach.) 3 marks.

The Socialized Conscience. By Prof. J. H. Coffin. Pp. viii+247. (Baltimore: Warwick and York, Inc.) 1.25 dollars.

Die Europaeischen Schlangen. By Dr. F. Steinheil. Heft 4. 5 plates. (Jena: G. Fischer.) 3 marks.

Die Kultur der Gegenwart: ihre Entwicklung und ihre Ziele. Teil iii. Abt. iv. Band 4, Abstammungslehre, Systematik, Paläontologie, Biogeographie. By R. Hertwig and R. v. Wettstein. Pp. ix+620. (Leipzig und Berlin: B. G. Teubner.) 22 marks.

The People's Books:—Wild Flowers. By M. Skene. Pp. 92. Applications of Electricity for Non-Technical Readers. By A. Ogilvie. Pp. 93. (London and Edinburgh: T. C. and E. C. Jack.) 6*d*. net each.

Ueber die Konstitution und Konfiguration von Verbindungen höherer Ordnung. By Prof. A. Werner. Pp. 21. (Berlin: J. Springer.) 1.20 marks.

The Elements of Qualitative Chemical Analysis. By Prof. J. Stieglitz. Vol. i. Parts 1 and 2. Pp. xi+312. Vol. ii. Parts 3 and 4. Pp. viii+153. (London: G. Bell and Sons, Ltd.) 6*s*. net each.

A Text-Book on Spherical Trigonometry. By Prof. R. E. Moritz. Pp. vi+67. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

Practical Mathematics for Technical Students. Part 1. By T. S. Usherwood and C. J. A. Trimble. Pp. 370. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

Rubber: its Sources, Cultivation, and Preparation. By H. Brown. Pp. xiii+245. (London: J. Murray.) 6*s*. net.

Wild Game in Zambezia. By R. C. F. Maugham. Pp. xii+376. (London: J. Murray.) 12*s*. net.

Board of Agriculture and Fisheries. Annual Report of the Horticulture Branch. Pp. 57+maps. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2*s*. 2*d*.

The History of the Indian Museum. By the Hon. Justice Sir A. Mookerjee. Pp. 76. (Calcutta.)

Memoirs of the Geological Survey of India. Vol. xliii. Part 1. Indian Geological Terminology. By Sir T. H. Holland and G. H. Tipper. Pp. 127+v plates. (Calcutta.) 2*s*. 8*d*.

The Algebra of Logic. By L. Couturat. Translated by L. G. Robinson. Pp. xii+98. (Chicago and London: Open Court Publishing Company.) 3*s*. 6*d*. net.

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1913. Pp. iv+426+iv appendices. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s*. 6*d*.

The Theory of Proportion. By Prof. M. J. M. Hill. Pp. xx+108. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 19.

ROYAL SOCIETY, at 4.30.—The Brain of Primitive Man, with Special Reference to the Cranial Cast and Skull of Eoanthropus (The Piltdown Man): Prof. G. Elliot Smith.—Oxidases: Prof. A. J. Ewart.—A New Malaria Parasite of Man: Dr. J. W. W. Stephens.—Investigations Dealing with the Phenomena of "Clot" Formations. II: The Formation of a Gel from Cholate Solutions having many Properties Analogous to those of Cell Membranes: S. B. Schryver.—The Influence of the Position of the Cut upon Regeneration in *Gunda ulvae*: D. Jordan Lloyd.

INSTITUTION OF MINING AND METALLURGY, at 8.15.—The Assay of Tin Ores: H. W. Hutchin.—The Assay of Tin Ores and Concentrates: The Pearce-Low Method: E. A. Wraight and P. Litherland Teed.—Formation of Mineral Deposits: Precipitation and Stratification in the Absence of Gels: W. P. Dreaper.—A Device for Filling Ore Sacks: T. R. Archbold.—A Mining Model: E. O. Marks.

LINNEAN SOCIETY, at 8.—The Origin of Species by Crossing: Dr. J. P. Lotsy.

CHILD STUDY SOCIETY, at 7.30.—Speech Defects of Children and their Treatment: Dr. E. W. Scripture.

FRIDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 9.—Busts and Portraits of Shakespeare and of Burns: An Anthropological Study: Prof. Arthur Keith.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—Some Modern Methods of Welding: T. T. Heaton.

INSTITUTION OF CIVIL ENGINEERS at 8.—The Use of Reinforced Concrete in Connection with Dock and Other Maritime Work: C. S. Meik.

SATURDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 3.—The Electric Emissivity of Matter: Dr. J. A. Harker.

MONDAY, FEBRUARY 23.

ROYAL SOCIETY OF ARTS, at 8.—Artistic Lithography: J. Pennell.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Sea Route to Siberia: Dr. Fridtjof Nansen and J. Lied.

TUESDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 3.—Animals and Plants under Domestication: Prof. W. Bateson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Bantu Coast Tribes of the East African Protectorate: Miss A. Werner.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Rail-steels for Electric Railways: W. Willox.—Rail-corrugation and its Causes: S. P. W. D'Alte Sellon.

WEDNESDAY, FEBRUARY 25.

ROYAL SOCIETY OF ARTS, at 8.—Rural Housing: T. Brice Phillips.

GEOLOGICAL SOCIETY, at 8.—Acid and Intermediate Intrusions and Associated Ash-Necks in the Neighbourhood of Melrose (Roxburghshire): Rachel W. McRobert.—Correlation of the Dinantian and the Avonian: Dr. A. Vaughan.

THURSDAY, FEBRUARY 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Diffraction of Light by Spheres of Small Relative Index: Lord Rayleigh.—(1) Studies of the Properties Operative in Solutions. XXXI. Sulphonic Acids and Sulphuric Acid as Hydrolytic Agents: A Discussion of the Constitution of Sulphuric and other Polybasic Acids and of the Nature of Acids; (2) Studies of the Properties Operative in Solutions. XXXII. The Influence of Sulphonates on the Hydrolytic Activity of Sulphonic Acids: A Contribution to the Discussion Influence of Neutral Salts: Prof. H. E. Armstrong and Prof. F. P. Worley.—Morphological Studies of Benzene Derivatives. V. The Correlation of Crystalline Form with Molecular Structure: A Verification of the Barlow Pope Conception of "Valency-Volume": Prof. H. E. Armstrong, R. T. Colgate, and E. H. Rodd.—The Magnetic Properties of Iron when Shielded from the Earth's Magnetism: Prof. E. Wilson.—The Occurrence of Ozone in the Upper Atmosphere: Dr. J. N. Pring.—(1) A Meteoric Iron from Winburg, Orange Free State; (2) The Electrification Produced during the Raising of a Cloud of Dust: W. A. D. Rudge.—The Electrical Ignition of Gaseous Mixtures: Prof. W. M. Thornton.

CONCRETE INSTITUTE, at 7.30.—Calculations and Details for Steel-frame Buildings from the Draughtsman's Standpoint: Cyril W. Cocking.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Motor and Control Equipments for Electric Locomotives: F. Lydall.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Industrial Possibilities of Nitrocellulose: C. A. Higgins.—Notes on the Fading of Dyed Silk: A. Jones and G. W. Parr.

FRIDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 9.—Surface Combustion: Prof. W. A. Bone.

SWEDENBORG SOCIETY, at 8.15.—The Body and the Soul in Swedenborg's Philosophy: Dr. L. de Beaumont-Klein.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Use of Reinforced Concrete in Connection with Dock and other Maritime Work: C. S. Meik.

SATURDAY, FEBRUARY 28.

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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ROYAL SOCIETY.

SORBY RESEARCH FELLOW.

The Committee, representing the Royal Society and the University of Sheffield, appointed to administer the Sorby Research Fellowship Fund, will proceed to the election of a Fellow after Easter. The object of the Fellowship is not to train men for original research, but to obtain advances in natural knowledge by enabling men of proved ability to devote themselves to research. The appointment will be for five years, subject to regulations, a copy of which may be obtained on application to the Royal Society. The emoluments of the Fellow will be approximately £500 per annum. The Fellow elected will be expected to pursue his investigations at the University of Sheffield unless the nature of the investigation requires that the work should be done elsewhere; he will be expected to enter upon his duties as soon after election as possible.

Applications from candidates for the Fellowship will be received by the Secretaries of the Royal Society, at Burlington House, London, W., up to April 20. Each application should contain a brief statement of the scientific career of the candidate, including his previous work, and a statement, as precise as possible, of the nature of the work to which he proposes to devote himself if elected.

Each candidate is requested to send one reference, but testimonials are not desired.

February, 1914.

THURSDAY, FEBRUARY 26, 1914.

WHAT OF THE ANCIENT UNIVERSITIES?

A History of University Reform from 1800 A.D. *to the present time, with suggestions towards a Complete Scheme for the University of Cambridge.* By A. I. Tillyard. Pp. xv+392. (Cambridge: W. Heffer and Sons, Ltd., 1913.) Price 10*s*. net.

THE unrest amongst the critics—favourable and adverse, with knowledge and without—of our ancient universities continues. The old foundations have been compared, sometimes not very intelligently, and put into competition with the newer university institutions. Men have formed themselves into camps, very strong views as to the merit of the type of university for which they were contending have been formed, and a few thoughtful and illuminating articles have appeared. Lord Curzon set the ball a-rolling at Oxford, and, although the momentum acquired is not yet great, things are moving, and it is being discovered that around finance centre most of the possiblities of improvement or reform. At Cambridge, syndicates of men with extreme views, associated with a number of more moderate men, have formulated schemes which have been so far mutually destructive, that after years of heated discussion it has at last been agreed to recommend *the re-arrangement of the method of paying degree fees.*

From this it may be argued with some point that those within the University do not realise the importance of the questions that are being raised outside the University. Oxford and Cambridge are not private corporations, but national institutions, and some of the would-be reformers hold that they have a right to ask these Universities to continue to fulfil the functions for which they exist. Throughout this controversy, however, it has been manifest that many who have taken part in it are not acquainted with existing conditions or the past history of the universities. It is not surprising, therefore, that attempts made to stir up the question of university reform have been futile. The author of the work before us, though a classical scholar and taking comparatively little interest in the scientific work of the University, has undoubtedly adopted the scientific method of collecting, sifting, and verifying facts and of considering the history of the University and its relation to their present attitude and position.

The work opens with a brief but very interesting history of the University, in which, of course, Cooper's "Annals," Mullinger's "History of Cambridge," and Goldwin Smith are largely drawn upon. Then follows a brief but sufficiently detailed account of the attack made by the *Edinburgh Review* on the University of Oxford; and we are taken step by step through the second attack made by the review and Sir William Hamilton, all this leading up to an account of the controversies out of which arose the Royal Commissions of 1850 and 1872, and of the series of legislative measures which brought the two Universities more nearly into line with modern methods and requirements. Of this phase our author writes out of the fullness of knowledge arising from a careful study of numerous documents and the collation of facts and statistics derived from many sources.

Perhaps the most interesting chapters in the book are those dealing with the legislation ending in the abolition of tests and clerical Fellowships, in the opening wider of the doors of the universities, in strengthening and welcoming men seeking a broader curriculum on which might be built up more advanced professional training, in the institution of college contributions to a common university fund, and in the foundation of the Financial Boards and of the various Boards of Studies. A full abstract account of the finances of the Oxford and Cambridge Colleges enables the reader to form some idea of their resources, and only after giving a really impartial statement of facts and figures are any suggestions offered for a scheme of reform, a scheme dealing specially with Cambridge.

It is maintained that although in recent years great advances have been made, the education provided by our national universities is too exclusive and, at the same time, too costly. The extreme exclusiveness of the colleges has been broken through to some extent, for they are anxious to attract by scholarships and exhibitions brilliant scholars from whatever source, and brilliant boys are welcome, whether they come from the State schools or from the great public schools. From the former and the smaller public schools come those who devote themselves to the mathematical, the natural science, the moral science, and tripos examinations other than the classical; and with the increase of the natural science and physical-science tripos work in the university there has been a great extension in the study of the applied sciences—engineering, medicine, and agriculture.

It may be pointed out—this with no wish to detract from the merit of an admirable book—that the passing of difficult examinations, even if done at small cost, is not always the best thing for the student. The university has a higher function than that of training examination wallahs by means of college tutors or the holders of several college and university offices, of university professors, some adequately, others very badly remunerated, or of lecturers or demonstrators so insufficiently paid that they must possess private means or undertake private coaching.

That the colleges have an important part to play in the training of men is accepted by the author, but he thinks that it should be brought home to them that where the college system is wasteful in the matter either of men or money, and where their interests clash with wider and greater interests, some attempt ought to be made to allow things to assume their proper proportions and perspective. Vested interests are firmly rooted and powerful, and the whole question is so complicated that it will be necessary to move warily, and to consider any suggested changes very carefully, but that some changes must come those who read this work will be thoroughly convinced.

Method rather than "subject" is the guiding factor in education, and it is recognised that the college system is valuable in the formation of character, but that the system might with advantage be modified very profoundly without impairing this special function scarcely admits of argument. Here finance is the key to the whole situation, and so long as the management of the bulk of the funds in the dual corporation of colleges and university remains with the colleges, any great economy appears to be out of the question. Those most intimately concerned appear to think that the colleges cannot transfer to the university any greater share of their endowments unless they can succeed in concentrating their forces and effecting great savings. If, then, the university is to avail itself of its great opportunities, it must look for additional support from the public, using all these terms in their widest sense.

It is interesting to find how some critics of the universities appear to belittle the physical and natural sciences as educative subjects; and even where they are pleading for the retention of these branches of knowledge in the university curriculum, to look upon them as supplying "soft options." Sir William Hamilton, speaking for these critics, argued that a university ought to teach the physical sciences because they require costly experiments, apparatus, and collected objects, whilst he looked upon the natural sciences as peculiarly fitted to the pass or poll men, and seemed to think that such subjects are worthy only of reception by inferior minds. By implication our author falls in with Sir William Hamilton, who says that "the knowledge which depends on the ocular demonstration of costly collections and experiments—this knowledge, easy and palpable, requiring an appliance more of the senses than of the understanding, can be fully taught to all, at once, by one competent demonstrator, the teaching of the natural sciences, therefore, ought to be 'professional' (professorial?)."

To some it appears that the university should concern itself not only with obtaining efficiency of education, but with elevating ideals, with raising the standard of culture, with the encouragement of research and the production of new knowledge, and with the building up of character. For all this the natural and physical sciences constitute as useful a medium as classics, mathematics or philosophy, whilst the latter, going hand-in-hand with science in the "search for truth," must, in the long run, prove irresistible.

All who take an interest in the welfare of our ancient universities should read this book; whatever may be their view as to the functions of these universities, they will here find, in convenient form, information that cannot but be valuable to them, information that hitherto has been accessible only to those who had the leisure and enthusiasm to read through an enormous amount of uninteresting detail in order to acquire material relevant to the subjects now under consideration. To many the book will be a call to action.

MEDICAL HYDROLOGY.

The Principles and Practice of Medical Hydrology. Being the Science of Treatment by Waters and Baths. By Dr. R. Fortescue Fox. Pp. xiv+295. (London: University of London Press, 1913.) Price 6s. net.

WITHIN the compass of fewer than 300 pages Dr. Fortescue Fox presents us with a most readable and comprehensive survey of the history and physiology of bathing, of hydrotherapy, of medicinal springs and baths, and of the indications for hydrological treatment. The author has so thoroughly digested his judiciously chosen material that he leaves the reviewer but little scope for criticism; and that material is presented in an easy flowing style which will commend itself to the non-professional reader as well as to the spa physician and the general practitioner. The lay reader will also find this book particularly useful for guidance in the hygienic use of baths for sensitive subjects and children.

The strong feature of the work, considered from the professional point of view, is the free use of physiology in explanation of the curative action of baths and waters, thus infusing into the empirical data of hydrotherapeutics the scientific element, which is the life-blood of an applied science, such as that of "medical hydrology"—the appropriate term adopted by the author. But in thus binding his facts together in scientific order, he repeatedly insists on the individual physiological factor presented by each case. The author reminds us that medical hydrology in this twentieth century is not taught in any of our schools, whereas in France, Germany, Austria-Hungary, Italy, Switzerland, Holland, Belgium, and in the United States, the student can obtain instruction in this department of medicine. The irony of our position in this matter is emphasised by the fact that the modern conception of the use of baths and waters in health and in disease actually originated with an Englishman, Sir John Floyer, of Driffield, who, in 1697, published his work entitled, "An Inquiry into the Right Use and Abuse of the Hot, Cold, and Temperate Baths in England." In a word, though England is its birthplace, hydrology has been mainly reared abroad.

The author advocates the establishment of a chair in hydrology in this country. This matter has our entire sympathy and support. But we should bear in mind that the teaching of that chair should embrace a wider range than that of hydrology; for in these days spas are undergoing a process of evolution, and are widening their therapeutic methods beyond the use of medicinal waters—the latter being supplemented by the adoption of other forms of physio-therapy such as treatment by electricity, light, the different rays, physical exercises of different kinds, &c. Therefore the spa physician should possess a good working knowledge of all the various physiological lines of treatment now adopted at our watering-places.

We trust that a progressive practical university, like that of London, will decide to set up a chair of "medical hydrology and physico-therapeutics," and allot it to a lecturer, such as Dr. Fortescue Fox himself, who has the experience of many years as a spa physician, and is endowed with the requisite scientific spirit.

GEOGRAPHICAL OUTLOOK AND CONTROL.

(1) *The Continent of Europe.* By Prof. L. W. Lyde. Pp. xv+446+maps. (London: Macmillan and Co., Ltd., 1913.) Price 7*s*. 6*d*. net.

(2) *Industrial and Commercial Geography.* By Prof. J. Russell Smith. Pp. xi+914. (New York: Henry Holt and Co., 1913.) Price 3.50 dollars.

(1) IN this important volume Prof. Lyde applies higher geographical methods to the treatment of the continent of Europe. The use of the word "higher" is intended to convey the fact that the volume is clearly intended for students at an advanced stage, if not, indeed, for their teachers. In fact, the reader is frankly faced, in the initial chapter, with five pages the difficulty of which there is no endeavour to conceal; it presupposes a very strong mental digestion, the active forces of which include a complete fore-knowledge of the tetrahedral theory of the earth's shape, and are expected to assimilate a philosophy of the "world-relations" of Europe, based (in part) upon that theory. These five pages passed, we are on easier ground when the regional relations of Europe, its relief in general and its climate, and the geographical "control" exercised by these factors, are considered. These topics occupy nine chapters, while the remainder deal with the four great European peninsulas, and within these, and thereafter, with divisions purely political. The regional relations of the continent are wisely made clear at the outset, and thereafter kept in subordination to the political divisions; geographical work of this character must necessarily proceed on these lines, and Prof. Lyde admits in his preface that he finds it "difficult to picture clearly the precise limits of a natural region"; it might, indeed, be asked whether anyone supposes that such limits exist.

Throughout the book geographical control is kept constantly in view, whether as exercised over natural distribution or over human activities. In a book of so general a character, it is a matter for congratulation that the author (unlike many writers of smaller volumes, in which the fault is even less justifiable than it would be here) refrains from straying into the domain of pure history, and only permits himself reference to historical facts in such cases, let us say, as that of a town which has risen or decayed from its former estate, and when in the explanation of such process a geographical factor is involved.

The author has some slight tendency (but here again he exercises more restraint than others) towards the creation of a vocabulary of his own, the necessity for which is not always apparent; he explains, however, and gives reasons in his preface for certain unfamiliar terms which he prefers, such as "wyr" and "wind-whirl." It is a matter for question whether he makes out a case for the exclusion of "cyclone" and "anticyclone," or whether geography, borrowing these terms from another department of science, with which it is in a condition of mutual dependence, has any right to attempt to replace them.

The book is fully mapped, Messrs. Philip's coloured physico-political maps being satisfactory; the textual maps and diagrams are of varying quality. The printers perhaps share with the author a certain disregard for system in the spelling of place-names; some signs lie outside their view, even one so necessary as the Swedish å, which is a different letter, with a totally different sound, from *a* in that language; the transliterations adopted for Balkan names are not always beyond criticism.

(2) Prof. Russell Smith's "Industrial and Commercial Geography" is laid out on no actually original lines, though they are in some respects unusual. He wholly omits the discussion of the general industry and commerce of countries individually. In a first part, which is headed "Industrial Geography," he deals with agriculture generally, and its departments—grains, domestic animals, fruit, sugar, and the like—with fisheries, with manufactures (forest industries, metal industries, and the rest), and with mineral industries. His second part, "Commercial Geography," deals with trade routes principally, and here perhaps, in comparison with other commercial geographies, this book has its chief value. The material for the analysis of trade routes has to be gathered from many sources, and is not easy to digest and adapt to geographical methods when gathered, and geographers owe Prof. Smith gratitude for his chapters on this subject. He deals successively with the trade routes of North America and Europe, with the North Atlantic route, with the routes of Asia, the North Pacific route, South American routes, African routes, and that of the Cape of Good Hope, those of Australasia and the South Pacific—a logical geographical sequence, occupying nine illuminating chapters.

There is the inevitable prophetic chapter on the Panama Canal; it is more acceptable than others of its kind, inasmuch as it refrains from conveying any expectation of instantaneous world-wide revolution in ocean-traffic when the canal is opened. There are numerous black-and-white maps and diagrams, and they reach a high standard of excellence in both style and reproduction—and this is a comment which it is not often possible to make upon American cartography. There are also a number of appropriate photographs.

This volume, like others before it, very clearly illustrates the difference of outlook upon commercial geography and geographical methods generally, as between American and British writers. There are not only many facts, but also whole chapters, in Prof. Russell Smith's work, which, so far from dealing with commercial geography as we understand it, are not even founded on a geographical basis. The British student is not led to expect in his geographical text-book any lessons in the balance of trade, or in specific methods of manufacture, except in so far as these may be dictated by geographical conditions. It may be that there is a mean to be struck between the two systems; if there is, it may lie in the direction of a more complete endeavour to describe the effects of industry on the surface of the earth—the appearance of the standing crop, the infinite variety in the aspect of manufacturing or other industrial centres or districts in different parts of the world. The connection of financial or other such industrial problems with geography is not apparent.

OUR BOOKSHELF.

The Animal Kingdom illustrated in twenty-seven coloured plates, containing several hundreds of species. The letterpress by Dr. Zwanziger, translated from the original German text by Gerard K. Gude. Pp. vi+92. (London: Society for Promoting Christian Knowledge, 1914.) Price 8*s*. 6*d*. net.

IN the matter of illustrations, this volume is above the majority of works of a similar type published in this country. Indeed, it may be said that it is excellent in this respect, notwithstanding that a few animals, such as the zebu and the buffalo, are drawn from immature or poor representatives.

In general style the text is well suited to readers for whom it is intended, being clear, simple, and not encumbered with technicalities. The translator, however, has in places followed the German text a little too literally, as in the use of "East India" and "Further India." It would, moreover, have been better if the author, instead of confining his remarks to particular species, had given some information with regard to the distribution of the genera to whch they belong in cases where this presents any special feature. It is, for example, throwing away an opportunity merely to state that one species of tapir inhabits South America, without a word as to the remarkable range of the group; this omission being still more marked in the case of the penguins, where it is stated that one selected species hails from the Antarctic. There is, however, a more serious matter connected with distribution, for we are informed on page 10 that rodents "are distributed over the whole globe, except Australia, where they are replaced by placental mammals." Whether, in this statement, "placental" is a slip of the translator for "implacental," we are unaware. Again, in the paragraph (p. 25) relating to marsupials, there is not a word with regard to their distribution; while on the following page it is stated that the opossum is a native of North America, when the reader should have been informed that it is an immigrant from South America, the home of the family.

Whether it was advisable to introduce scientific names may be a matter of opinion, but as this has been done care should have been taken not to be so behindhand as to include the roebuck in the same genus as the red deer. A more serious error occurs on page 24, where *Balaena mysticetus*, the name of the Greenland whale, is misapplied to the common fin-whale, which, by the way, is neither the largest animal in existence nor attains a length of 90 feet. R. L.

Things Seen in Oxford. By Norman J. Davidson. Pp. 258+plate. (London: Seeley, Service and Co., 1914.) Price 2s. net.

If Mr. Davidson's little book on Oxford is to be recommended to the readers of Nature, it must be on the understanding that they are not to expect guidance in scientific matters. We read with surprise that the University Museum "is excelled by no other in the world for its completeness in the Natural Sciences," and that "during the winter months Oxford is invariably flooded." Neither statement is wholly true. The information on undergraduate life also is somewhat antiquated, for the average undergraduate now goes bareheaded, and when he gets back to his rooms in the evening is more likely to switch on his light than to "turn up his lamp." But then it not infrequently happens that to visitors "things seen in Oxford" differ considerably from the same things as known to residents. The illustrations from Taunt's photographs are excellent.

Indian Administration. By Prof. Vaman G. Kale. Pp. vi+298. (Poona: Aryabhushan Press, 1913.) Price 1.4 rupees.

The machinery of Indian government and administration is described in this book in a manner which should appeal to the ordinary, intelligent Indian citizen. One chapter is devoted to Indian education, and provides a summary of progress and policy since 1854. From one of Prof. Kale's tables we find that in 1912 there were in India 187 colleges concerned with higher education, and that 36,334 students were in attendance at them. The existing provision for university education is not, it is urged, adequate to the ever-growing demand, and new seats of learning will have to be founded in parts of the country where there are at present no facilities.

The Examination of School Children. A Manual of Directions and Norms. By Dr. W. H. Pyle. Pp. v+70. (New York: The Macmillan Company, 1913.) Price 2s. net.

As Dr. Pyle says, an accurate knowledge of the mental and physical characters of each child under his care would assist greatly a schoolmaster's lessons. The object of this little book is to provide directions for the examination of the mental and physical natures of school children, and to supply tables dealing with normal cases of various ages. It is to be feared that ordinary teachers have not the necessary knowledge and experience to make trustworthy tests, but the hints given should prove of value to psychological and medical experts.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Weather Forecasts in England.

The Meteorological Offices of this and some other countries issue weather forecasts each day for the succeeding twenty-four hours, these forecasts being based on information telegraphed from various surrounding stations. They are often, but not always, right, or partly right, and it may not be without interest to compare the actual weather, first, with the official prediction, and then with such predictions as might be made without any information except such as can be gathered on the spot from the barometer and the "look of the weather."

The British Isles, with no land to the west and south (except the Azores) for some thousand miles, are unfortunately situated as regards weather prediction, for the greater part of the changes which affect them come from a part of the Atlantic which is traversed by comparatively few steamers, and from which, therefore, but few wireless messages can be received, and no other source of information is available. Central Europe and America are better off in this respect.

With the view of examining the correctness of the English forecasts, I have recently gone through the weather reports for 1913, and extracted from them those forecasts relating to the London and S.E. district, which is perhaps the most favourably situated for prediction. The results of this examination, though they refer only to a single district for a single year, will give some idea of the use of telegraphic information, but before considering the tables in which these results are stated, I will add a few general remarks.

There are in England four clearly distinguished types of weather, namely, those which accompany winds from the south to west, north to east, west to north, and east to south, their relative frequency being in the order stated.

The characteristics of each type are:—

S. to W.—Warm, wet, cloudy.

N. to E.—Cold, dry, with haze.

W. to N.—Cold, clear air, with hail in spring.

E. to S.—Very variable in character.

There are, of course, frequent exceptions, but in the main these are the leading features of winds from the respective quadrants. The correct prediction of the type of weather is for most purposes more important than that of the amount of rain or sunshine to be expected.

In regard to whether forecasts are to be judged as right or wrong, it must be noticed that in our Weather Reports they are often so worded as to make a decision difficult, and to bring to mind the fortuneteller's "dark man" and "fair man." The wind, for instance, is to be "light, moderate, fresh, or strong," or "strong at times in places." For the weather, "Some rain, fog, or mist, but with fair intervals." The temperature is described as "moderate," "rather warm," "cool," "below normal," and so on, but whether it is rising or falling is rarely stated.

Rain, cloud, and sunshine are more variable than wind or temperature, and in the following table I have considered only the latter two.

In marking the forecasts as right or wrong, regard has been had in the first place to direction of the wind and secondly to its strength. If, for instance, a west wind is predicted and a S.S.W. follows, this would be marked "right," but a W.N.W. wind "wrong," because this type of weather accompanying the two is different. So with regard to easterly winds, if, say N. is predicted and E.N.E. follows, this would be "right," but an E.S.E. following on the prediction of N.E. would be "wrong."

With regard to strength, the forecasts often make anything less than a gale a possibility.

The temperature forecasts are generally vague, but if a rise of temperature occurs when the prediction is "cool," this would be marked "wrong," or, again, if moderate temperature is predicted and the true temperature differs much from the average for the time of year. So far as possible I have given a favourable interpretation to all the forecasts with the results which are here shown in Table I.

TABLE I.—*Comparison of Weather in London in* 1913 *with the Forecasts made on the Previous Day. The actual Weather is Judged from the Morning Weather Chart of the Day.*

—	Wind				Temperature			
	Right	Wrong	?	No forecast	Right	Wrong	Doubtful	No forecast
January ...	18	9	—	4	15	10	2	4
February..	13	11	—	4	14	8	2	4
March ...	14	7	4	6	13	7	4	6
April ...	15	10	1	4	13	9	4	4
May ...	13	11	3	4	12	13	2	4
June ...	17	6	2	5	14	9	2	5
July ...	20	6	1	4	12	11	4	4
August ...	14	8	4	5	15	9	2	5
September	12	12	2	4	13	8	5	4
October...	13	13	1	4	15	10	2	4
November	13	9	1	7	11	7	5	7
December	19	5	3	4	14	8	4	4
Total ...	181	107	22	55	161	109	38	55
Percentage on No. of forecasts	58	34·5	7·5	—	52	36	12	—

So far therefore as the present very limited examination goes, the probability of finding the predicted weather on the morning of the day succeeding the forecast is as follows:—

	Wind	Temperature
Probability for ...	0·58	0·52
,, against ...	0·35	0·36
,, doubtful ...	0·07	0·12

TABLE II.—*Change of Type of Weather.*

—	Changes of type	Forecast		Percentage of correct forecasts
		Right	Wrong	
January... ...	15	11	4	73
February ...	10	8	2	80
March	9	4	5	44
April	11	7	4	63
May	14	10	4	71
June	6	4	2	66
July	12	10	2	83
August	9	4	5	44
September ...	13	7	6	54
October ...	18	15	3	83
November ...	12	6	6	50
December .	9	7	2	78
Total	138	93	45	789
Percentage .	—	67·4	32·6	—

Table II. shows the number of changes of type of weather, as reckoned by the direction of the wind. This is intended to indicate the correctness of the forecast as regards *change* of weather, and here the percentage of success is higher, being 67·5.

It will be noticed that during the year the type of weather changed 138 times. If, therefore, anyone with no information whatever had been content with saying "To-morrow will be like to-day," he would have been wrong 138 times, and right 227 times, and the probability in favour of his prediction being 0·62, and against 0·38. With the help of a barometer and ordinary local observation, he might probably improve on this somewhat.

Comparing these figures with the results obtained by such a fairly complete knowledge of the simultaneous conditions in surrounding regions as is afforded by telegraph day by day to the Meteorological Office, it does not appear that for this latitude and country the odds in favour of the latter are large.

On looking over the immense mass of figures—considerably more than 1000 entries—which are used in the construction of each Weather Chart, I am reminded of a sentence in the late Sir G. (then Mr.) Airy's report to the board of visitors of the Greenwich Observatory in 1867, when speaking of the proposed increase in the number of meteorological observatories, "whether the effect of this movement will be that millions of useless observations will be added to the millions that already exist, or whether something may be expected to result which will lead to meteorological theory, I cannot hazard a conjecture." De Morgan quotes this sentence (the last in the report in question) in his "Budget of Paradoxes," and remarks:—"This *is* a conjecture, and a very obvious one: if Mr. Airy would have given 2½*d.* for the chance of a meteorological theory formed by masses of observations, he would never have said what I have quoted."

Personally, I think it extremely improbable that any trustworthy weather forecasts for periods so long as twenty-four hours will, or can, ever be made for regions outside latitudes 30 N. or S. or thereabouts, with the exception perhaps of a few places where the local conditions are paramount.

The reasons for this view will be given in a subsequent note.

A. MALLOCK.

February 17.

The Darwinian Theory of Atolls.

IN the review of "Letters and Recollections of Alexander Agassiz" (NATURE, January 29)—an article in which we are given a picture of an exceptionally interesting personality drawn by an intimate friend—there is a brief paragraph on the formation of coral reefs to which I should wish to refer.

My friend, Sir Ray Lankester, concludes that Agassiz "certainly succeeded in showing that the views advocated by Darwin and by Dana are not capable of universal application, nor, indeed, of general validity" (pp. 603–4).

It would be unreasonable to claim "universal application," but "general validity" is a matter to be determined by a comparison of the number and extent of the regions in which Darwin's explanation holds good with the number and extent of those in which it does not. The results of the Funafuti boring offer, I think, important evidence in regard to the Pacific area. A test locality was chosen with the utmost care by unbiassed authorities. A bore-hole was drilled, at great expense and in spite of many difficulties, to a depth of 1100 ft. *Only shallow water organisms were found in the core.* For some reason or other—probably because it is more exciting to overturn than to confirm—very little has been said about this evidence. We all hope for more borings; but in the meantime the only important trial that has been made entirely supports the validity of Darwin's theory, in the locality selected as a test.

EDWARD B. POULTON.

Oxford, February 20.

The Accuracy of the Principal Triangulation of the United Kingdom.

THERE was some discussion of this question at the last meeting of the British Association, and an investigation by Capt. H. St. G. L. Winterbotham has been published by the Ordnance Survey (Professional Papers, new series, No. 2). It appears, however, that the measurement of Lossiemouth Base, valuable as it was, did not definitely decide the question, but that a moderate amount of further computation would do so.

(1) It will be generally admitted that statistical evidence as to the precision of any kind of observation is of no great value unless it is based on a large population. For example, if we may assume the principal triangulation to have been all executed by similar observers under similar conditions, and no unjustifiable rejections to have been made, we may accept with great confidence the probable error of $\pm 1{\cdot}23''$ computed from the closure of 552 triangles. But nowadays one would not think of estimating the precision of a base-line by the discrepancy between two measurements of it, though one might reject the measurements if they did not agree as well as was to be expected from the known usual probable error of a measurement. Thus discussion of a large population of discrepancies gives a good estimate of the probable accidental error of a measurement, but a small population only fixes a lower limit to that probable error. Now we have only a population of three independent discrepancies between the four bases of Lough Foyle, Salisbury Plain, Lossiemouth, and Paris, and even if it is brought up to six by the inclusion of the three bases measured with steel chains, yet it must be considered a very small population upon which to base any estimate of precision.

(2) But the original question, to what extent the strength of the figure compensates for the large probable error of an angle, is not necessarily a question for experiment, but it is essentially a question for computation. Given the probable error of an angle in a block of triangulation adjusted rigorously by least squares, if it is required to find the probable error of the distance from any point of it to any other point, the first step is to express the unknown error in that length as a linear function of the unknown errors in a number of independent angles (*i.e.* two angles of each triangle in a chain of independent triangles stretching from one point to the other, and in another chain stretching from one of the points to the nearest base). It then remains only to add another column to the least square computation by the method described in Wright and Hayford's "Adjustment of Observations," paragraph 123. May I venture to suggest that if two or three such cases could be worked out for strong figures in the United Kingdom, and for comparison two or three cases for weaker figures, either there or elsewhere, it would not only set at rest the immediate question, but would also establish results of great importance for surveyors in general.

T. L. BENNETT.

Computation Office, Egyptian Survey Department.

ONE can but agree with Mr. Bennett in insisting on a large "population" of discrepancies upon which to found a calculation of a probable error, whether it be of the measurement of a base-line or of an angle. His example of a base-line measurement is not, however, strictly comparable with the investigation in question. In the former a large number of independent measurements must be made from which to deduce the most probable length and the individual discrepancies from this length. In the latter the measured bases may be regarded as errorless compared with the triangulation, and the actual errors can therefore be deduced with surety.

Neglecting the steel chain bases, we have four independent measures upon any one of which the triangulation can be made to depend. These four are widely distributed.

The longest line from base to base is that from the new base at Lossiemouth to the Paris base, and along this line the old steel chain bases add additional proof that no serious errors are inherent in the triangulation.

I agree that, "if we may assume the principal triangulation to have been all executed by similar observers under similar conditions and no unjustifiable rejections to have been made, we may accept with confidence the probable error of $1{\cdot}23''$ computed from the closure of 552 triangles," but it must be remembered that this is the probable error of an observed angle. The date of the work makes this a matter of no surprise. The point at issue, however, is not the probable error of an observed angle, but the probable error of an adjusted angle, or, in other words, to find out how far the intricacy of the figure has compensated for the lack of precision of angular measurement.

To say that this question is essentially one for computation is not, to my mind, correct.

The probable error of the ratio of any two sides as derived from the triangulation depends upon the probable error of an adjusted angle. This calculation is possible, but from the complexity of the figure and the intricate system of weighting the angles, impracticable. Moreover, the answer to it would still be the probable, and not the actual, error.

It is, however, possible to pick out of the general figure chains of simple triangles connecting the bases. Supposing that these chains had been the only paths of calculation, and that they had shown the same errors of ratio between the bases as are actually found, we can deduce what the probable error of an observed angle would have been to have effected this result. Such an investigation has been made, and the probable error of an observed angle in these "equivalent" simple chains is $0{\cdot}85''$, or approximately the same as that given by General Ferrero, in his 1892 report, as the mean figure for the probable error of an observed angle in the triangulations of those twenty countries represented on the International Geodetic Association.

Although, therefore, further investigation on the lines advocated by Mr. Bennett would be one of the greatest interest, I do not think that it promises a result commensurate with the time and expense it would entail.

H. S. L. WINTERBOTHAM.

Atomic Models

I AM indebted to Mr. Chalmers for pointing out (NATURE, February 19, p. 687), what I had indeed suspected, that the magnetic moment due to an electron moving in a circular orbit, assuming the angular momentum to be $h/2\pi$, is *exactly* five times the magnetic moment of the magneton. The original value ($15{\cdot}94 \times 10^{-22}$) of the latter quantity, given by Weiss, and quoted in my former letter, was based on the value of Avogadro's constant found by Perrin. If we divide the magnetic moment of the atom gram, $1123{\cdot}5$, by the more recent value for Avogadro's constant given by Millikan ($60{\cdot}62 \times 10^{22}$) we obtain as the magnetic moment of the magneton $18{\cdot}54 \times 10^{-22}$, which is exactly one-fifth of the value of the magnetic moment, $92 \cdot 7 \times 10^{-22}$, for the electron moving in a circular orbit.

Sir Oliver Lodge has directed attention to the importance of all cases where commensurable numbers enter into physical problems. Mr. Chalmers thinks that the present result indicates that, in magnetic materials, there is a unit of five (or ten) atoms, which has a constant number of magnetons. Since in the last resort we must consider magnetism to be an atomic property, I should prefer to regard the result as affording further evidence for the view that the magnetic effects of the complex nucleus must be taken into consideration. The magneton may then result as a difference effect.

To make this clearer, it may be worth while discussing a simple illustrative model. Prof. Peddie has put forward some interesting suggestions as to the structure of the atom in the February number of the *Philosophical Magazine*. He supposes that the atom may be built up of concentric spherical shells of electrification, which may be in rotation round a common axis. Following this suggestion, suppose we have a uniform sphere of positive electrification of radius A rotating with angular velocity Ω. Outside this, suppose we have a single ring containing n (from 1 to 8) valency electrons. The remaining negative electrification may be relegated to a central core having no rotation. Then the magnetic moment of the rotating sphere may be taken as $\frac{1}{5}EA^2\Omega$, where E is the total positive charge, which we shall assume equal to Ne.

We have no direct evidence as to the value of $A^2\Omega$, but if for convenience we assume that it has the same value as $a^2\omega$ for a ring electron, we obtain the result that the magnetic moment of the rotating core is equivalent to 2N magnetons. The resultant magnetic moment for such a model would be the difference between the 2N magnetons of the core and the $5n$ magnetons of the ring. This is only intended to illustrate the way in which the magneton may be introduced as a unit for measuring magnetic moments without involving the necessity of a single magneton existing as an independent entity. If the core of an atom is built up of α and β particles in orbital motion, the experimental results of Weiss indicate that the resultant magnetic moment of these particles can be expressed in terms of the magneton.

H. S. ALLEN.

Wheatstone Laboratory, King's College, London, W.C.

Origin of Structures on the Moon's Surface.

IN NATURE of February 5 Dr. Johnston-Lavis writes, "the more I compare the moon's surface with volcanic vents, in different parts of this world, the less I see a resemblance between the two," and "the more does the planetoid and meteorite projectile theory become acceptable."

G. K. Gilbert, in his address to the Philosophical Society of Washington, 1892, gives an extremely interesting summary of the various theories to account for the features of the moon's face. After a very clear description of the phenomena to be accounted for, he accepts the meteorite theory with modifications. He remarks that, if the so-called craters of the moon were due to the impact of meteors, their form would be for the most part elliptical, whereas, in fact, they are circular. His own theory is that the earth was at one time attended by a ring similar to that which encircles the planet Saturn, and that this afterwards "gradually coalesced, gathering first around a large number of nuclei, and finally all uniting in a single sphere," the moon. He attempts to show that this hypothesis accounts for the facts.

In NATURE (vol. xxv., p. 243, 1862) I suggested that when, according to Sir G. H. Darwin's view, the moon broke away from the earth and commenced an independent existence, the scar left by the great catastrophe forms now the basin of the Pacific Ocean. The same idea was elaborated five years later by Prof. Pickering (*Journal of Geol.*, vol. xv., No. 1, 1907). It is evident that if the Pacific Ocean indicates the place from which the moon departed, the continents surrounding it must have been then in existence and the earth covered with a solid crust. Both Prof. Pickering and myself make this assumption. The question which I would ask, therefore, is this: Does the moon's surface bear traces of this mode of origin?

The material detached from the earth would have been partly solid, derived from the cooled crust, and partly liquid, derived from the molten substratum. The expulsion would have been probably explosive, owing to the gases dissolved in the substratum. The material would consequently have been scattered. Subsequently it would have collected about its centre of gravity, the smaller masses falling in last. The paths of the falling masses would have been radial. What the telescope now reveals would be the final effect after the mass had settled into the spherical form. May not, then, the circular so-called craters have been caused by the impact of fragments of the solid crust, and may not the mountains of the moon be also angular portions of the earth's crust projecting above the mean spherical surface of the moon?

The above suggestions do not exclude the possibility of true meteors also having fallen, and left their mark upon the moon, but it is not probable that many *large* meteors have struck the moon, because they are rare upon the earth, and if many *siderites* had so fallen, the moon's specific gravity would have been higher than it is, viz., about 3.

It has occurred to me to inquire at what distance from the earth's surface the centrifugal force would balance the earth's attraction, because it is difficult to see how the material, which is supposed to have been detached from the earth to make the moon, could have got away until that distance was reached.

This condition is expressed by the equation, $a\omega^2 = g\frac{a^2}{r^2}$, where a is the earth's radius, 20,926,202 ft., ω the angular velocity, assumed in this case to be $2\pi/18{,}000$ seconds, g gravity, 32 ft. a second, and r the distance from the centre required. From this I get the required distance from the earth's surface, viz., $r-a$, equal to 53,205,200 ft., or more than double the earth's radius. How this distance could be reached seems unaccountable.

Sir G. H. Darwin, in the summary of his paper on the remote history of the earth, does not refer to this point; but since his theory has been adopted without demur by Sir Robert Ball and Prof. Pickering, the difficulty which strikes me must be more apparent than real. Can some reader of NATURE explain it?

O. FISHER.

Graveley, Huntingdon.

I HAVE read with a great amount of interest the letter by Dr. Johnston-Lavis which appeared in the issue of NATURE for February 5, as regards the ray systems of the moon from a vulcanologist's point of view. Even taking into consideration his explanations, however, I cannot now help comparing the moon with our own planet, especially when Laplace's nebular hypothesis, and subsequent theories in reference to the relation of the moon to the earth are considered, which seem to prove conclusively that the moon was once a portion of this world. Then with regard to his remarks about the lava flows from a crater, though I am by no means an authority upon this subject, such as Dr. Johnston-Lavis, I would beg to point out that the lava from the crater of Skaptar Jokul in the year 1783 formed two main streams which flowed for a distance of forty to fifty miles each, and varied in thickness or depth from 600 to 1000 ft. Now I cannot help thinking that such streams, only so much bigger, might have flowed from the craters of the moon, and it is well known that enormous floods have issued from volcanoes in the Sandwich Islands without much eruption of rocky, or pumaceous débris, which might hide the effect of the lava, as Dr. Johnston-Lavis suggests, though Prof. Pickering puts forward the suggestion that it is some material, such as pumice, which we see in the moon's rays. Apart from which geologists tell us that apparently in prehistoric times lava seems to have issued from vertical fissures, and deluged large areas, as is well seen in the great basalt plain of Snake River, Idaho, North America. Assuming that these fissures were caused by the contraction of the earth's outer crust when cooling, and again comparing the moon with the earth, we at least come to Nasmyth's well-known theory as regards these ray systems, though the manner in which these peculiar phenomena radiate from the craters still seems to suggest to me the same actions which took place from Skaptar Jokul, and in the Sandwich Islands. However, assuming Dr. Johnston-Lavis to be correct in his objections to this theory, I should like to know if he considers Nasmyth's theory any more likely to solve this interesting problem?

Then with reference to the meteorite theory, it seems to me that this scarcely satisfies all the objections. In the first place, these rays are in many cases as wide as ten to twenty miles, and of a very considerable length, and it would take a meteor or other body of excessive size to cause such markings, apart from which the speed would have to be truly prodigious, and, however horizontally the object was approaching the lunar surface, the gravitational attraction, though comparatively slight, would tend to divert the path into a vertical one to some other portion of the surface. Again, it is a curious coincidence that by far the greater number of these rays radiate from the principal craters, and if the meteorite theory is correct, how is it they crossed such a huge-walled crater as Clavius without apparently breaking down its walls, though leaving their marks? The rills and clefts certainly lend themselves to this theory, though when we consider the Sirsalis cleft, 300 miles long, and that there are no fewer than forty in the interior of Gassendi, it becomes difficult to explain even these.

I certainly agree with Dr. Johnston-Lavis, that a practical astronomer with a high-power instrument ought to collaborate with a thoroughly practical vulcanologist, when perhaps some satisfactory explanation would be arrived at. Until then, I am afraid things will have to remain as they are.

C. HUBERT PLANT.

Lichfield Road, Walsall, February 10.

The Discovery of Australia.

IN a note in NATURE of November 27, 1913 (p. 379) relative to the Houtman's Abrolhos Islands, the remark is made:—"The wreck of the Dutch East India Co.'s ship, the *Batavia*, under the command of Capt. Pelsart, in 1629, is said to have led to the first recorded discovery of Australia."

Without entering into the vexed question of who first discovered Australia, I may point out that there are records of more than a dozen visits of Dutch ships and one English ship to the northern and western coasts of Australia before 1629. In fact, the general outline of the whole of the present State of Western Australia and of the Gulf of Carpentaria was known to the Dutch before that date.

The Abrolhos Islands were discovered by the ships *Dordrecht* and *Amsterdam*, under the command of Frederik de Houtman, whose name they still bear, in 1619 (vd. Heeres, "The Part Borne by the Dutch in the Discovery of Australia"). They were rediscovered by the ship *Tortelduif* in 1624, and the East India Co. recognised their danger to navigation, and had accordingly issued warnings to the commanders of all its vessels before Pelsart sailed from Holland.

From a scientific point of view the wreck of the *Batavia* is of most interest, because it led to the discovery of the first member of the kangaroo family, viz., the Dama Wallaby, *Macropus eugenii*, which is plentiful on the two largest islands of the group.

As it is generally supposed that the first discovery of the kangaroo was made by Sir Joseph Banks on Captain Cook's first voyage in 1770, I think that zoologists may find Pelsart's account of this smaller species, written nearly 150 years earlier, of interest.

He says:—"We found in these islands large numbers of a species of cats, which are very strange creatures; they are about the size of a hare, their head resembling the head of a civet-cat; the fore-paws are very short, about the length of a finger, on which the animal has five small nails or fingers, resembling those of a monkey's forepaw. Its two hind legs, on the contrary, are upwards of half an ell in length, and it walks on these only, on the flat of the heavy part of the leg, so that it does not run fast. Its tail is very long, like that of a long-tailed monkey; if it eats, it sits on its hind legs, and clutches its food with its forepaws, just like a squirrel or monkey.

"Their manner of generation or procreation is exceedingly strange and highly worth observing. Below the belly the female carries a pouch, into which you may put your hand; inside this pouch are her nipples, and we have found that the young ones grow up in this pouch with the nipples in their mouths. We have seen some young ones lying there, which were only the size of a bean, though at the same time perfectly proportioned, so that it seems certain that they grow there out of the nipples of the mammæ, from which they draw their food, until they are grown up and are able to walk. Still, they keep creeping into the pouch even when they have become very large, and the dam runs off with them when they are hunted."

W. B. ALEXANDER.

The Western Australian Museum and Art Gallery, Perth, Western Australia, January 10.

DAILY SYNOPTIC CHARTS OF THE NORTHERN HEMISPHERE AND ABSOLUTE UNITS.

ON January 1 of this year, as already mentioned in the Notes of the issue of NATURE for February 5, the Weather Bureau of the United States commenced the issue of a daily weather map of the northern hemisphere, compiled from observations received daily at Washington by telegraph.

In addition to the regular reports from the United States and Canada, represented in the well-known daily weather map of the bureau, reports are obtained from upwards of forty stations, which are sufficiently distributed in latitude and longitude to form the basis of a chart of isobars and isotherms for the northern hemisphere. The information is given on the back of the daily bulletin, and the Weather Bureau is to be congratulated upon being the first to publish a map showing the distribution of pressure and temperature over a hemisphere *on the day of issue.*

It rests with the bureau, or with some still more enterprising institute if there be one, to add the available observations from the southern hemisphere, and realise what everyone who thinks about the subject knows to be the most sure basis for the study of the daily weather, viz., a daily map of the main features of the distribution of pressure and temperature over the globe.

Practically no lines are drawn on these maps for latitudes lower than 25°, and it is interesting to speculate as to what sort of characteristics a synoptic chart of the equatorial regions would show if it could be drawn. North of 25° the rotation of the earth makes it possible for pressure differences represented by "parallel isobars" to be sufficiently permanent to be charted, while ordinary centrifugal action makes "circular" isobars also equally possible. Hence on a chart for temperate and polar regions, isobars may take any shape between the small circle of a cyclonic depression and the great circle of "straight" isobars; but in the equatorial region there is no place for "parallel isobars," as they are understood further north, because the influence of the rotation of the earth is too feeble; the winds required to balance isobars such as those to which we are accustomed would be prodigious. Consequently a pressure distribution sufficiently permanent to be mapped could only be made up of "circular" isobars, and therefore a chart of isobars for part of the equatorial region ought to be a collection of small circles with whatever may be necessary to represent the diurnal variation. It would be interesting to have this conclusion verified, and the transition between the region of circular isobars and the region of straight isobars carefully explored.

Variations of pressure, small in magnitude, but associated with weather changes, are shown as irregularities in the course of the well-known diurnal variation, on barograms for equatorial regions, and the translation of a collection of barograms into synoptic charts is an attractive problem. It would presumably tell us what the meteorological conditions would be if the earth were fixed and the sun went round it in twenty-four hours as the ancients used to suppose.

One of the striking features of the maps now issued by the Weather Bureau is that for the first time in the history of official meteorological institutions, c.g.s. units of pressure and the absolute scale of temperature are used for a daily issue of charts. The isobars are figured for every five millibars, and the isotherms for every ten or five degrees on the centigrade scale measured from 273° below the freezing point of water.

This is indeed a remarkable step towards the unification of the methods of expressing pressure over the globe, and it has been immediately followed by the Meteorological Office in the corresponding charts which are published in the weekly weather report. The office figures the centibars, while the bureau figures the millibars, but that is only a matter of decimal point.

Millibars are in future to be used, though not exclusively, for the international publication of the results of the investigation of the upper air, so that while it now seems likely that before many years are passed we may see a daily synchronous chart for the globe, and really begin to study weather as it ought to be studied, we may at the same time expect to take leave of the inch and the millimetre as measures of pressure. They certainly have had a very long innings on a side to which they did not properly belong, and it will be interesting to see how the more scientific measure of pressure in pressure-units will adapt itself to practical requirements. The Meteorological Office is to make use of c.g.s. units of pressure for the Daily Weather Report on May 1 of the current year, and the preparations for that event have already placed some well-known facts in a curious light. The task which during the last sixty years we have been setting to British instrument-makers is as follows:—"Construct a barometer which will give a true pressure reading when the whole instrument is in latitude 45°, the mercury at 273° A., and its brass case at 290° A." Continental makers have had a problem that sounds simpler, viz. to construct a barometer which will give a true pressure reading when the instrument and its case are in latitude 45° at 273°A. The figures show that if instrument-makers were to make a barometer which was correct at the equator at the freezing point of water, it would be correct in latitude 45° at the ordinary air-temperature of 289° A. (61° F.) and at the poles at 305° A. (89·6° F.). So for each latitude there would be a temperature within the common range for which the readings were true pressures. At other temperatures, of course, a correction would be required. W. N. S.

THE RECENT SEISMOLOGICAL DISTURBANCES IN SOUTH JAPAN.

IN the accompanying figure is reproduced, on about half the original scale, an interesting seismogram received from Prof. A. Belar, of Laibach, through the courtesy of the foreign editor of the *Daily Mail.* The earthquake in question occurred on the morning of January 12, and was recorded by a Galitzin seismograph with electromagnetic damping. The times indicated on the diagram are referred to mean time of central Europe, which is one hour in advance of Greenwich time. In a second letter, Prof. Belar gives 10h. 40m. 35s. as the time of arrival at Laibach of the first preliminary tremors, and he estimates that the earthquake occurred at 6h. 29m. 2s., p.m., Japan time.[1] According to

[1] According to the data given by Prof. Belar in a more recent letter, it would seem that the time at the origin should be 6h. 30m. 13s (mean time of 135 E.) p.m., which does not differ materially from that given above.

information recently received from Japan, 337 earthquakes occurred in the south of the country on January 12, the strongest of all being recorded at Nagasaki at 6h. 29m. 27s. The coincidence is so close as to justify Prof. Belar's conclusion that the earthquake recorded at Laibach originated near the south coast of Japan. That the earthquake was of considerable strength is evident from an account by the Rev. A. C. Hutchinson, of Kagoshima, which appeared in *The Times* for February 6. "The earth," he says, "seemed to leap convulsively upwards. The quaking was so great for two minutes that it was difficult to stand."

Prof. Belar remarks that the interest of the seismogram is due to the possible connection of the earthquake with the eruption of Sakurajami on the same day. As a rule, the foci of volcanic earthquakes are close to the surface, and the vibrations are insensible, even with instrumental aid, at considerable distances from the epicentre. If the shock recorded at Laibach were of volcanic origin, this would be the first instance of a volcanic earthquake being recorded across an entire continent since the horizontal pendulum was adapted for seismographic purposes.

Of earthquakes connected with a volcanic eruption, those which are due to the actual explosions are usually of less intensity than those which occur at other times, while the strongest shocks may originate at some distance from the volcano. For instance, in the south-west corner of Hokkaido (the northern island of Japan), there is a group of volcanoes, of which three—the Komaga-take, the Tarumai-san, and the Usu-san—have been active recently. Earthquakes are extremely rare in this part of the country, but each of the last four eruptions has taken place in fairly close connection with a strong earthquake the epicentre of which has been from sixty to 170 miles from the volcano.[1]

It seems clear that the earthquake of January 12 must have originated at some distance (perhaps fifty miles or more) from the recently active volcano of Sakurajami, for the seismic sea-waves which swept over the low-lying parts of Kagoshima arrived half-an-hour or more after the earthquake was felt in that city. But, notwithstanding this, it seems probable that Prof. Belar is correct in assigning to the earthquake a place among the volcanic phenomena, and to its focus a depth considerably greater than is usual in volcanic earthquakes.

C. DAVISON.

[1] F. Omori, Bull. Imp. Earthq. Inves. Com., vol. v., 1911, pp. 5–7.

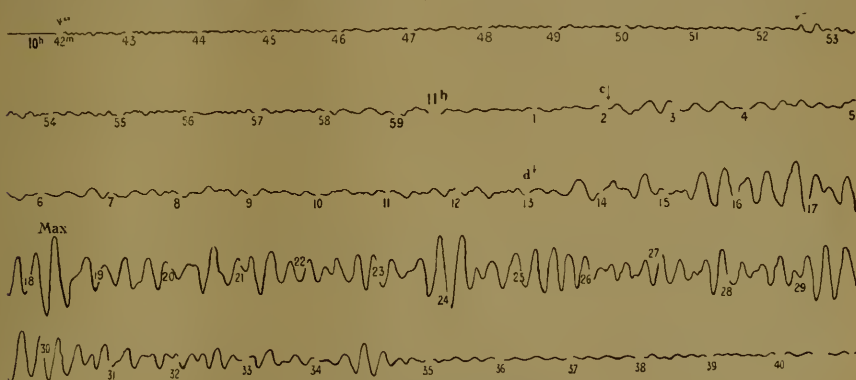

FIG. 1.—Seismogram obtained at Laibach, Austria.

ALBINISM.[1]

THE word albinism is used in several senses. In the strictest sense it is used only of cases in which pigment is completely, or apparently completely, absent from the skin, hair, and eyes; in the widest sense it includes many grades of deficiency of pigment, whether generally over the body or in restricted areas. The memoir before us illustrates the difficulty of defining albinism, for according to the authors all grades of pigment reduction occur, both in Man and other Vertebrates, so that no sharp line would seem to exist between total and partial albinism. There is little doubt, however, that a number of quite different causes may give rise to pigment reduction, and that much might be done to classify the various manifestations into natural groups. Some of the more outlying types are already clearly separable, *e.g.* pathological leucoderma, and the whitening of the hair of certain species in winter, which is due to a shedding of pigmented hair and its replacement by white in autumn, followed by moult in the other direction in the spring.

Another group of so-called albinotic cases can be separated by their mode of inheritance. An inspection of pedigrees at once reveals the fact that some cases of "partial albinism" in man, in which the skin is spotted with white, or in which there is a white patch of hair on a body

[1] "A Monograph on Albinism in Man." By Karl Pearson, F.R.S., E. Nettleship, F.R.S., and C. H. Usher. Part ii., Text. Pp. 265–524 + atlas. Price, 30s. net. Part iv., Text. Pp. iv.+136+xxiii+atlas. (London: Dulau & Co., Ltd., 1913.) Price, 21s. net. (Drapers' Company Research Memoirs. Biometric Series, viii. and ix.)

otherwise normally coloured, are inherited as typical Mendelian dominants, the affection being always transmitted in the direct line. On the other hand, many, probably the majority, of cases of complete or nearly complete albinism behave as recessives, and appear especially in the offspring of consanguineous marriages between affected stocks.

When the more sharply defined cases have been separated out, there remains a large mass of material which still requires analysis, and one of the most hopeful ways of dealing with this seems to be by a comparison with cases in animals which have been or might be worked out experimentally. Such experiment has already shown, first, that skin and coat colour is due to the combined effect of at least two separately inherited factors, one of which is necessary for the production of any kind of pigment, while the other determines the colour of the pigment which is produced. Vertebrate albinos are commonly produced by the absence of the first factor, and may therefore bear the factors which determine particular colours, although they do not show them. Albinos are therefore not all alike in their inherited constitution, and it is probably only by disentangling the various factors involved that a complete understanding of the causes of human albinism will be obtained. Secondly, experiment with animals shows that piebalding is completely distinct from total albinism in its inheritance, and that if a piebald appears when an albino is crossed with a self-colour, this is not due to mosaic inheritance, but to the fact that the albino bears the factor for piebalding—is, in fact, a piebald from which the pigment factor is lacking. Thirdly, there is evidence that some cases of lack of pigment are due to an inhibiting factor which interferes with the development of pigment, even in the presence of both the required colour-factors. When complications of this kind have been shown to exist in animals which can be subjected to rigorously controlled experiment, it is not surprising that the examination of human albinos and their pedigrees reveals irregularities.

A comparison with animal cases suggests, however, that by the careful collection of evidence, and especially by the classification of cases (1) according to the results of clinical observation, supplemented by microscopical examination when possible, and (2) according to the mode of inheritance, much could be done to disentangle the various factors which are involved. Much of the preliminary work in this direction could be done with the data now available, but as long as we continue to group together, in thought as well as in name, such different phenomena as total absence of pigment, general reduction of pigment, piebalding, and wall-eye, and, from the point of view of inheritance, cases which are clear Mendelian dominants, others which are scarcely less clearly recessive, and others, again, which have undoubted sex-limited inheritance, so long the present confusion will continue.

The monograph before us, though scarcely making any attempt at a classification such as we suggest, will provide most useful material for future workers on the subject. It gives a full account of the clinical and microscopic characters of various kinds of albinism in the widest sense of the word, both in man and animals; discusses their occurrence and geographical distribution, and includes, in part iv., nearly 700 fully described pedigrees, some of them extending to 100 or more individuals.

PROF. S. P. LANGLEY AND AVIATION.

I have brought to a close the portion of the work which seemed to be specially mine, *the demonstration of the practicability of mechanical flight*; and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others. The world, indeed, will be supine if it do not realise that a new possibility has come to it, and that the great universal highway overhead is now soon to be opened.

THUS spoke the late secretary of the Smithsonian Institution, Samuel Pierpont Langley, after his memorable experiment of May 6, 1896, in which he launched a heavier-than-air machine in the air, which flew under its own power (steam), traversing a distance of half a mile. This experiment it was that convinced the world of the practicability of mechanical flight, and which crowned the success of all his previous experimental researches. It was not until the year 1903 (December 17) that the Brothers Wright, Wilbur and Orville, fitted a motor to their gliding machine, and made two flights, the first successful flights ever made by man in a heavier-than-air machine driven by its own power.

It was a fitting tribute of the Board of Regents of the Smithsonian Institution to found, on December 15, 1908, a Langley medal "to be awarded for specially meritorious investigations in connection with the science of aerodromics and its application to aviation," and it was most appropriate that the brothers Wilbur and Orville Wright were the first (1909) to receive the award. The presentation of this medal is now made on May 6, a date selected in order that the ceremonies incident to the presentation may take place in connection with the observance of "Langley Day," which was established by the Aero Club of Washington in 1911 to commemorate Langley's achievement.

A recent Smithsonian Institution publication (No. 2233) contains an account of the exercises on the occasion of the presentation of the Langley Medal and the unveiling of the Langley Memorial Tablet on May 6, 1913, including the addresses of Dr. Alexander Graham Bell, Monsieur J. J. Jusserand, the Ambassador to the United States, Dr. John A. Brashear, and the secretary, Dr. Charles D. Walcott. The bronze memorial tablet is situated in the Smithsonian building, and represents Prof. Langley seated on a terrace where he has a clear view of the heavens, and, in a meditative mood, is observing the flight of birds, while in his mind he sees his aerodrome soaring above them.

The second and third medals were awarded to Mr. Glen H. Curtiss and M. Gustave Eiffel, the former "for advancing the art of aerodromics by his successful development of a hydro-aerodrome, whereby the safety of the aviator has been greatly enhanced," and the latter "for advancing the science of aerodromics by his researches relating to the resistance of the air in connection with aviation."

The orations are interesting reading, especially that by Dr. Brashear, who was one of Prof. Langley's oldest and closest friends.

The publication contains reproductions of the Langley Tablet and of the two handsome medals. The illustration of the medal awarded to M. Eiffel is here reproduced.

At the close of the exercises, the secretary directed attention to the action of the Board of Regents, who have decided on the re-opening of the Langley Aerodynamical Laboratory. Sufficient provision is available to start and continue the work in a modest way, and it is hoped that investigations under the name of Langley will be pursued to develop and standardise aeronautical science.

FIG. 1.—Langley medal presented to M. Gnstave Eiffel.

Such an institution well organised and equipped would be a noble monument to the man, and one which he, no doubt, would have most desired.

NOTES.

THE attention of the British Science Guild was directed towards the end of last year to the fact that the Post Office authorities were contemplating a charge of two guineas, in respect of licences in connection with apparatus proposed to be installed by owners of observatories, watch and clock makers, &c., for the purpose of receiving the international wireless time signals sent out from the Eiffel Tower. Protests against the proposed tax had been forwarded to the Post Office authorities by the National Association of Goldsmiths, the British Horological Institute, and Mr. F. Hope-Jones, chairman of the Wireless Society of London. In consequence of the representations made to it upon the subject, an inquiry was instituted by the British Science Guild in relation to the wisdom of the policy of levying such a charge at the present time, the possibility of collecting the same economically in the event of the policy being persisted in, as well as in relation to the powers conferred on the Postmaster-General under the Wireless Telegraphy Act, 1904. The result of this inquiry was such as to persuade the guild that the imposition of a tax would be impolitic, and at the same time would not be likely to produce a revenue commensurate with the expense involved in attempting to collect the same, whilst such a tax could not fail to give rise to intense irritation. As was pointed out in an article in NATURE of November 13, 1913 (p. 320), it appeared to be extremely doubtful whether the Postmaster-General possessed statutory authority to impose such a tax, since by the terms of the Wireless Telegraphy Act, 1904, it is expressly provided that "nothing in this Act shall prevent any person from making or using electrical apparatus for any purpose other than the transmission of messages." The views of the British Science Guild were recently forwarded to the Secretary of the Post Office, who was desired to place the document containing these views before the Postmaster-General for his consideration, and at the same time the Postmaster-General was requested to receive a deputation from the guild in relation to this matter. We learn that the representations of the British Science Guild and other bodies have been considered by the Postmaster-General, who has now intimated that he does not intend to proceed with the proposal to levy the contemplated tax.

Prof. P. Ehrlich, director of the Royal Institute for Experimental Therapeutics, Frankfort-on-Main, has been awarded the Cameron prize of the University of Edinburgh, in recognition of his discovery of salvarsan, of his researches on numerous synthetic organic compounds of arsenic, and of his important work on immunity.

The twenty-third annual meeting of the Royal Society for the Protection of Birds will be held at the Westminster Palace Hotel, Victoria Street, London, S.W., on Thursday next, March 5. The chair will be taken at 3 p.m. by the Right Hon. Lord Newton. A resolution will be submitted in favour of the Government Plumage Bill.

Prof. W. P. Bradley, who has occupied the chair of chemistry at Wesleyan University, Middletown, Connecticut, since 1893, has resigned that post on accepting a position as chemist with a large rubber company. He is especially known for his work on problems connected with the liquefaction of permanent gases, and he conducted the first liquid air plant that was set up in America for research purposes.

Sir James Wilson, K.C.S.I., has been appointed to act as delegate for Great Britain and Ireland, the Dominions of Canada, Australia, New Zealand, the Union of South Africa, and the Government of Mauritius on the permanent committee of the International Institute of Agriculture at Rome. Lieut.-Colonel Sir David Prain, director of Kew Gardens, Sir James Wilson, and Mr. A. G. L. Rogers, head of the Horticulture Branch of the Board of Agriculture and Fisheries, are the representatives of the Board at the International Phytopathological Conference opened at Rome on Tuesday, February 24.

A committee has been appointed in Berlin to make arrangements to celebrate the seventieth birthday of Prof. A. Engler on March 25 next, by the presentation to him of his life-size marble bust and in other ways, as a sign of the appreciation of botanists of his varied and valued contributions by publication and otherwise to the advancement of systematic, geographical, and economic botany. Readers of Nature who may wish to join the botanists of Germany and other countries in this celebration are invited to send their subscription to Prof. T. Johnson, Royal College of Science, Dublin, for transmission to, and acknowledgment by, Prof. L. Wittmack, of Berlin.

At the anniversary meeting of the Geological Society of London, held on Friday last, February 20, the officers were appointed for the ensuing year as follows:—*President,* Dr. A. Smith Woodward, F.R.S.; *Vice-Presidents,* Dr. H. H. Bemrose, Mr. W. Hill, Mr. Clement Reid, F.R.S., and Dr. A. Strahan, F.R.S.; *Secretaries,* Dr. H. H. Thomas and Dr. H. Lapworth; *Foreign Secretary,* Sir Archibald Geikie, O.M., K.C.B., F.R.S.; *Treasurer,* Mr. Bedford McNeill. The awards of medals and funds, announced in Nature of January 15 (p. 561) were made. The president delivered his anniversary address, which dealt with problems of post-glacial denudation.

At the annual general meeting of the Physical Society of London on February 13, the following officers were elected for the ensuing year:—*President:* Sir J. J. Thomson, O.M., F.R.S. *Vice-Presidents* (not including those who have filled the office of president): Prof. T. Mather, F.R.S., Dr. A. Russell, Mr. F. E. Smith, and Mr. R. S. Whipple. *Secretaries:* Mr. W. R. Cooper and Dr. S. W. J. Smith. *Foreign Secretary:* Dr. R. T. Glazebrook, F.R.S. *Treasurer:* Mr. W. Duddell, F.R.S.. *Librarian:* Dr. S. W. J. Smith. *Other Members of Council:* Dr. W. H. Eccles, Sir R. A. Hadfield, F.R.S., Prof. G. W. O. Howe, Prof. J. W. Nicholson, Major W. A. J. O'Meara, C.M.G., Mr. C. C. Paterson, Prof. O. W. Richardson, F.R.S., Prof. the Hon. R. J. Strutt, F.R.S., Dr. W. E. Sumpner, and Dr. R. S. Willows. *Assistant Secretary and Reporter:* Mr. J. Guild.

We learn from *The Pioneer Mail* that the foundation-stone of the School of Tropical Medicine at Calcutta was to have been laid on February 24. The Government of India has provided six lakhs of rupees for the site and laboratory, and has agreed to contribute towards the upkeep of the school, thus emphasising the Imperial character of the work. An appeal is made for liberal endowments. The building will accommodate several whole-time research workers, in addition to the teaching staff. Four lakhs, or annual subscriptions of 20,000 rupees, guaranteed for at least five years, will be required for the endowment of each additional research investigator. The possibilities of carrying out important investigations of tropical diseases, which cause more than one-third of the deaths in Calcutta, and at least as large a proportion over India as a whole, are limited only by the amount of financial support which may be afforded to the new institution.

Mr. Victor Anestin, of Bucharest, referring to Mr. W. F. Denning's note in our issue of February 12 (vol. xcii., p. 670) on the detonating fireball of January 19, sends us fuller particulars of the old Rumanian superstition that bolides may be abundantly observed from January 14–20, and especially on January 19. The superstition has been held for hundreds of years by peasants and townsfolk alike. The belief is that on January 19 "les cieux s'entr'ouvrent," and young people look out for this celestial phenomenon, believing that if they offer up a wish at the moment of its occurrence it will be granted during the same year. The same belief is held concerning the appearance of fireballs on November 17. In both these months the sky is always covered with cloud at Bucharest, so that a bright fireball produces an effect of the heavens opening as expressed in the superstition. The date January 19 is, however, not fixed; sometimes the meteors are seen several days before, and at other times after that date. Thus in 1906 "le ciel s'est entr'ouvert" on January 14, and this year the luminous effects of the meteors were seen on January 21.

Dr. Louis Bell writes from Boston, U.S.A., to describe an unusual meteorological phenomenon observed there last month. On January 13, which was the coldest day known in Boston for many years, the thermometer not ranging above zero for a period of thirty hours extending through the entire day, Dr. Bell, upon entering a large train shed, some 75 ft. high and of a very extensive area, found that snow was steadily falling, produced by the congelation of the steam from the numerous locomotives. The interesting point was that the snow had aggregated into flakes of fair size, not distinctly crystalline, but still flakes, in spite of the short distance of the possible fall. The thermometer was then about 5° F. below zero, and in the evening at a similar temperature the whole interior of the train shed was still white with this deposit of snow. The general phenomenon, of course, has been many times recorded, but is very rarely seen, particularly on so large a scale and for so long a time.

THE exceptionally mild character of the present winter is being maintained until its close, and for a persistent continuance of warm days in January and February it surpasses all previous records. At Greenwich the thermometer in the screen was above 50° for eighteen consecutive days from January 29 to February 15 Previous records since 1841 have no longer period than eleven days, in the months of January and February combined, with the thermometer continuously above 50°, and there are only four such periods—1846, January 21–31; 1849, January 16–26; 1856, February 6–16; and 1873, January 4–14. Besides these there are only three years, 1850, 1869, and 1877 with a consecutive period of ten days in January and February with the temperature above 50°. The persistent continuance of tne absence of frost is also very nearly a record. To February 24 there have been thirty consecutive days at Greenwich without frost in the screen, and the only years with a longer continuous period in January and February are 1867, with thirty-seven days, 1872, with forty-three days, and 1884, with thirty-two days. The maximum temperatures in the two months have seldom been surpassed. In many respects there is a resemblance between the weather this winter and that in 1899, when in February blizzards and snowstorms were severe on the other side of the Atlantic, with tremendous windstorms in the open ocean, whilst on this side of the Atlantic the weather was exceptionally mild. It is to be hoped that this year we shall be spared the somewhat sharp frosts experienced in the spring of 1899.

THE annual Home Office report and statistics of the output of mines and quarries in Great Britain for the year 1912 has been published. It is greatly to be regretted that the report should take nearly a twelvemonth before the definite figures of the year's mineral production can be published, as by this time these figures present but little interest. It is true that the approximate figures issued at an earlier date give a great deal of the information, and that the early figures rarely require much alteration. As a matter of fact, however, the Department of Mineral Statistics, like so many departments of the Government that do useful but not showy work, is neglected in favour of others that make a more direct appeal to the gallery. Our Department of Mineral Statistics is understaffed, and the collection and definition of mineral statistics are not, as they should be, controlled by precise and definite legal enactments. Thus it is impossible to know from the report whether the item coal means "drawings," inclusive of "walings," or whether it refers to clean coal only; or, again, whether the quantity of coal is inclusive or exclusive of colliery consumption. What is really needed in this country is a brief Mineral Statistics Act, regulating the precise manner in which the various statistics should be collected and tabulated, and giving legal force to the definitions now so loosely employed, and if such an Act could be drawn up as the result of an international conference, so that the statistics of the great mineral-producing countries of the world could be correctly compared with each other, a great advance would be made towards the scientific study of this important branch of knowledge.

IN the February issue of *Man*, Sir C. H. Read describes a remarkable Bactrian bronze ceremonial axe which has been recently added to the British Museum collections. It is composed of the figures of three animals—a boar, a tiger, and an ibex. The cutting edge is formed of the back of the first, which is attacking the tiger, who is turning round and gripping the flanks of a crouching ibex. Our present scanty knowledge of the archæology of Afghanistan in the centuries preceding the Sassanian dynasty does not admit of any distinct statement of the uses to which an object of this kind might be put, nor are we able to interpret the symbolism of the conjunction of these three animals. The nearest analogy is an axe presented to the British Museum by Major P. M. Sykes, from Kerman in Persia. In this the animal forms are degraded and almost lost; but a second axe of the same find has the beasts standing free and well-defined, though the execution is not so artistic as in the present example, which, by comparison with the Oxus treasure in the museum, is probably a specimen of the art of Bactria about the time of Alexander the Great.

ACCORDING to the reports published in the December issue of the Proceedings for 1913, the Philadelphia Academy of Sciences appears to have had a prosperous year, having received during that period two considerable money bequests, while a number of cases in the museum have been rearranged. The accessions to the library were nearly 1000 in excess of those in the preceding year.

PARTS viii. and ix. of Dr. Koningsberger's "Java" contain a brief account of the fishes of the island—both fresh-water and marine—which are stated to be still very imperfectly known. Another section is devoted to the reptiles, in which it is stated that Schlegel's gharial (*Tomistoma schlegeli*), of Sumatra, Borneo, and the Malay Peninsula, may not improbably occur in Java, although definite evidence is not yet forthcoming.

THE question whether a certain number of fertilised female house-flies (*Musca domestica*) pass the winter in a dormant condition, to revive and produce progeny in the spring, according to a note by Mr. E. A. Austen, of the British Museum, in the February number of *The Entomologist's Monthly Magazine*, still awaits a definite answer. An American observer, Dr. H. Skinner, has, indeed, committed himself to the statement that house-flies pass the winter only in the pupa-stage, but this is not in accord with the views of Messrs. Newstead and Jepson in this country. The point is of considerable importance in connection with the crusade against house-flies as disseminators of disease.

To the Journal of the East Africa and Uganda Natural History Society for December, 1913, Mr. R. B. Woosnam, Game Warden for British East Africa, communicates an important article on the relation of game animals to disease in Africa, with special reference to the proposal to clear off such game animals in certain parts of East Africa with a view of stamping out tsetse-fly disease and other maladies. The theory hitherto largely favoured by experts is that game animals alone serve as "reservoirs" for the trypanosomes, and other blood-parasites, by which such diseases are caused; but the author points out that not only is there a strong probability, but likewise a practical certainty, that other animals serve in a similar capacity. And this being so, the futility of attempting to kill off all the game animals in certain districts is self-apparent. In the opinion of the author, a far more hopeful plan is to rely on the possibility of producing or accelerating immunity to the diseases in question in the animals liable to be infected. "If," writes Mr. Woosnam, "wild animals can acquire an immunity in nature and domestic native cattle can also acquire immunity [which in certain instances they undoubtedly do], is it not possible that the greatest success may eventually result from an artificially produced immunity?"

In a valuable report on the effect of water on the cultivation of cotton (Egyptian Ministry of Finance Survey Department, Paper No. 31, 1913), Messrs. Hughes and Hurst, who were assisted in their field work by Messrs. Bolland and Ferrar, give details of a series of experiments made with a view of eliminating other factors in an estimate of the influence upon the cotton yield of the level of saturation in the soil. Their general conclusion is that with the subsoil water at a low level fairly heavy watering gives greater yields than very light watering, which may easily be pushed so far as seriously to affect the yield. They find, however, that fairly heavy watering delays the ripening of the crop, and they point out that too wide an interpretation is not to be placed on the results obtained from the experiments, the chief importance of which lies in the methods adopted, especially the arrangement of the experimental plots in such a manner as approximately to eliminate the effect of factors which varied from point to point of the fields.

It would appear, from investigations by Mr. W. R. Dunlop (*West Indian Bulletin*, vol. xiii., No. 4), that certain groups of varieties of sugar-canes possess differentiating characteristics as regards their stomata, and that if the general morphological and anatomical characters of the varieties be taken into consideration, each one variety can be identified by its leaf alone. The stomatal density per unit of area is one of the chief characteristics, though in the investigation under review the range of variation has not been determined with sufficient accuracy to permit more than the classification of the varieties examined into groups as regards stomatal densities. The relation of the ratio of the total stomatal area to the entire surface of the leaf, and the susceptibility of any variety to drought is discussed, and actual observation has shown that a variety possessing a high stomatal area with other hydrophyllous characters appears to be unsuited for cultivation in areas of low rainfall and humidity. Whether any general relation exists between sucrose content of varieties and stomatal characteristics has yet to be determined, but such observations would appear to provide a useful guide in future selection of sugar-cane for drought resistance.

One of the useful articles in the recently published Journal of the Scottish Meteorological Society (vol. xvi) is a somewhat laborious investigation of "A Possible Two-hourly Period in the Diurnal Variation of the Barometer," by Mr. M. M'Callum Fairgrieve. The paper was suggested by certain departures from a smooth curve every alternate hour, shown by the result given by Dr. Chree in a paper on the barometric pressure at Castle O'er (Quart. Journ. Roy. Met. Soc., October, 1911). Mr. Fairgrieve examined long series of observations at some of the Meteorological Office observatories, and other places, and found that a two-hourly oscillation was very apparent at certain places, while at others there was little indication of any such variation. The author finds it difficult to assign a proper explanation of the results obtained, whether physical or instrumental, but suggests that it is obviously of importance that the point should be cleared up.

It is well known that while the number of regular solids is limited, a similar limitation extends to "polytopes" in multi-dimensional space, the cube, regular tetrahedron and octahedron being the only types which can be extended indefinitely to the higher dimensions. There are, however, certain semi-regular polyhedra which play an important part in crystallography. We have now received papers from Dr. P. H. Schoute, reprinted from the transactions of the Cambridge Mathematical Congress, and Dr. E. L. Elte (Amsterdam Proceedings, 1912), dealing with the different degrees of regularity and characteristics of the various semi-regular polytopes in multi-dimensional space. While these interesting problems are being competently treated by mathematicians, the popular fallacy of "*the fourth*" dimension seems as hard to eradicate as ever. Prof. Samuel M. Barton's article in *The Popular Science Monthly* for October is correct enough in its geometrical facts, but the use of the word "fourth," for the more correct terms, "four" and "many," will be likely to militate against the usefulness that would accrue from an essay dealing professedly with "hyperspaces."

After conference with the American incandescent lamp manufacturers, the United States Bureau of Standards has issued a sixth edition of its circular containing standard specifications for such lamps. Although the specifications were originally intended for the use of Government departments only, the public has made such large demands for them that an annual edition has appeared since the circular was first printed in 1907. Another circular for which the demand is likely to be extensive is that on copper wires, prepared at the request of the American Institute of Electrical Engineers. It contains nearly seventy pages of tables and other information about copper wire, brought thoroughly up to date, last year's work of Mr. G. L. Heath on the relation between the purity and temperature coefficient of resistance of wires being included.

THE January number, which begins the career of the *Annales de Physique* as a separate publication, consists of ninety-six pages of the same size and style as the *Annales de Physique et de Chimie* have made us familiar with in the past. The annual volume is to extend to nearly 600 pages, and the price outside France is to be 28 francs. Profs. Lippmann and Bouty are the editors, and the first number is certainly a credit to them. It contains a communication by M. Violle on physical units to be adopted in France, a second by M. Brillouin on a relation between specific heat and radiation of a body independent of the quantum hypothesis, a third by M. Marcelin on the thickness of films spread on the surface of water, in which it is shown that the thickness of a camphor film may be as small as the diameter of a camphor molecule, and, lastly, the first part of a long paper by M. Croze describing experiments on the emission spectra of the commoner gases

A CIRCULAR (No. 43) has been issued by the Bureau of Standards at Washington with reference to the international metric carat of 200 mg., which was adopted on July 1 last by the United States customs service as the unit for determining the import duties on precious stones. Tables of equivalents are included in the circular, which will be useful to diamond dealers in converting from the old unit to the new and *vice versâ*. The value adopted for the old carat is 205·3 mg., which is the average weight of the various carats previously in use in the United States. This is precisely the same value as that of the old carat hitherto used in the United Kingdom, which is to be displaced on April 1 next by the metric carat of 200 mg., in accordance with the Order in Council of October 14 last. The tables would accordingly be useful also to British jewellers for conversion purposes; they are much more complete and practicable than those issued by some American firms of gem dealers in the form of "folders," and are followed by some valuable hints on the care and use of balances and weights for weighing precious stones.

THE July to December, 1912, number of *Isis*, the publication of the Dresden Society for Natural Knowledge, contains a paper by Mr. H. Dember on the relationship between atmospheric electricity and wireless telegraphy. The theory has been advanced that electric waves suffer reflection from an ionised layer in the upper atmosphere, and that the development of this layer by day causes the difference between day and night wireless phenomena discovered by Marconi. The author's object was to secure direct evidence of such ionisation. As ultra-violet light is rapidly absorbed by the earth's atmosphere, he pursued his inquiries in Switzerland, near Arolla, at considerable heights, the one 2000, the other 3400 metres, above sea-level. The ionising action of sunlight, it is argued, must increase equally the number of negative and of positive ions. The latter normally preponderate in number, thus sunlight must tend to increase the ratio borne by the number of negative to the number of positive ions. The free ionic charges in the atmosphere were observed in the usual way with Ebert's apparatus, while the ultra-violet radiation was simultaneously measured by a simple apparatus designed by the author. The results of the observations, which were made on five days in August and September, 1911, are illustrated by figures, which show on the whole a parallelism between the variations of the ultra-violet radiation and the magnitude of the ratio of the ionic negative to the ionic positive charges. The author allows that the observed effect, even at 3400 metres, was probably due in large part to a vertical current or convection of ions produced at greater heights in the atmosphere. The same paper describes some interesting observations on the absorption of sunlight of various wave-lengths made in August, 1912, in the Italian Alps, with a new apparatus. The results are discussed in reference to Lord Rayleigh's theory of atmospheric action.

THE "Wratten and Wainwright Division" of Kodak, Limited, have just issued a fifty-page pamphlet on reproduction work with dry plates. They make out a very strong case for the use of panchromatic gelatine plates in direct screen negative making for three-colour work, claiming not only that gelatine is as good as collodion, but that it is much preferable, when the photographer has become accustomed to it. But the plate must have a fine grain, be very sensitive to red and green, and give great density and contrast, characteristics which are found in the Wratten process panchromatic plate, which is rendered colour sensitive by "bathing," that is, immersion in the dye solution after the plate is coated. The pamphlet is intended for the guidance of the block-maker, and gives detailed suggestions with regard to each step in the process. We learn that the laws of geometrical projection are good and sufficient guides for regulating screen-distance, so that after the innumerable pages that have been written on this subject, the whole matter may, for practical purposes, be expressed in a line or two. The reason why greens are so difficult to reproduce is fully explained. A choice of six pairs of colour filters for two-colour work is given, and there are several other items of interest, even to those who regard such matters from a merely theoretical point of view.

MUCH interest was aroused by the preparation in 1910 of an optically-active oxime of the formula

$$\begin{array}{c} \mathrm{H} \diagdown \diagup \mathrm{CH_2{-}CH_2} \diagdown \\ \mathrm{C} \mathrm{C{=}N.OH} \\ \mathrm{HO.CO} \diagup \diagdown \mathrm{CH_2{-}CH_2} \diagup \end{array}$$

The preparation of this compound afforded the first concrete evidence that the three bonds of the nitrogen atom were not in a plane, and so provided a solid foundation for the theory which Hantzsch and Werner had put forward in 1890 to account for the isomerism of certain oximes of the aromatic series. In the January issue of the Chemical Society's Journal, Dr. W. H. Mills and Miss Bain describe an extension of these experiments, in which they have succeeded in isolating active salts of the semicarbazone,

$$>C{=}N.NH.CO.NH_2,$$

and benzoylphenylhydrazone,

$$>C{=}N.N(C_6H_5).CO.C_6H_5,$$

of the same ketone. The resolution of the former compound was effected by means of morphine, that of the latter by means of quinine. The rotatory powers were transient, but of large magnitude, $[M]_D$ 30 to 40° for the semicarbazone, and as high as $[M]_D$ 238° for the hydrazone. The experiments strongly support the hypothesis that "the three valencies of the doubly-linked nitrogen atom do not lie in one plane, but are directed along the three edges of a trihedral angle."

THE control system of the Panama Canal locks is described in *Engineering* for February 20. The control houses contain horizontal control boards—the board at Gatun is 64 ft. long—on which are arranged all the control handles and indicators, the board taking the form of a miniature representation of the locks. Indicators are provided showing the opening of the various valves, the height of water in the locks, &c. Small model leaves show each gate in plan, and working models of the chain fenders are also provided at the proper places. All the indicators and models follow and reproduce the conditions in the full-size lock exactly, except in certain cases, when an "open" or "closed" indication suffices. The form of indication system adopted is of interest. Step movements such as are obtainable with ratchets, &c., were ruled out as inadequate, and an electrical system involving the use of 732 small indicator motors has been developed. A complete synchronous indicator set consists of a transmitter, located at, and driven by, the operating machine, whether in the case of the sluice-valves or other gear, and a receiver and indicator worked thereby in the control house.

DIRECTORS of education and others responsible for the erection and fitting of new science laboratories would do well to study the new, excellently illustrated catalogue entitled "Laboratory Fittings and Furniture," published by Messrs. Reynolds and Branson, Ltd., of Leeds. The plans and photographs of recent laboratories, for the fitting and equipment of which this firm has been responsible, which are included in the catalogue, will prove useful guides for persons planning new laboratories, and the other particulars will be found arranged in a manner which makes reference very easy.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR MARCH:—

March 2. 11h. 0m. Saturn at quadrature to the Sun.
3. 21h. 36m. Jupiter in conjunction with Uranus (Jupiter 0° 9′ N.).
4. 14h. 39m. Saturn in conjunction with the Moon (Saturn 6° 47′ S.).
6. 14h. 44m. Mars in conjunction with the Moon (Mars 1° 49′ S.).
7. 20h. 6m. Neptune in conjunction with the Moon (Neptune 4° 35′ S.).
10. 4h. 0m. Mercury in inferior conjunction with the Sun.
11. 16h. 13m. Moon eclipsed, partly visible at Greenwich.
20. 23h. 11m. Sun enters sign of Aries; spring commences.
21. 14h. 58m. Uranus in conjunction with the Moon (Uranus 2° 32′ N.).
,, 20h. 39m. Jupiter in conjunction with the Moon (Jupiter 2° 26′ N.).
22. 6h. 0m. Mars at greatest heliocentric latitude N.
,, 13h. 0m. Mercury stationary.
24. 4h. 16m. Mercury in conjunction with the Moon (Mercury 1° 8′ N.).
27. 9h. 55m. Venus in conjunction with the Moon (Venus 4° 16′ S.).

A FAINT COMPANION TO CAPELLA.—An interesting discovery has been made by Dr. R. Furuhjelm (*Astronomische Nachrichten*, No. 4715), who has found that Capella, a spectroscopic double star, is accompanied by a faint companion (phot. mag. 10·6) at a very great distance. The absolute positions of the stars, according to the Helsingfors Catalogue plates are as follows:—

	α 1900·0 h.	m.	s.		δ 1900·0 °	′	″	Epoch
Capella ...	5	9	18·09	...	+45	53	49·1	1895·42
The faint star	5	10	1·26	...	+45	44	23·9	1895·42

The companion is distant from Capella by 12′ 3·3″, and the position angle is 141° 20′. The discovery was made by comparing the proper motions of the stars in the neighbourhood of Capella determined from photographs of the region taken at two different epochs at Helsingfors. Dr. Furuhjelm's proper motion for the faint star gave the values 0·422″ in the direction 170·9°, while the values for Capella as determined by Boss were 0·438″ in the direction 168·7°. Other stars in the vicinity have no such physical relationship.

THE SOLAR SYSTEM.—The following neat empirical formula connecting certain elements of the known planetary satellites is given by M. F. Ollive in a modest little note communicated to the French Academy of Sciences (*Comptes rendus*, vol. clvii., No. 26, p. 1501). Let R′ represent the mean distance of the satellite from the planet around which it gravitates, v' its orbital velocity, R the mean distance of the planet from the sun, and r its mean radius, then, M. Ollive states, $r^3 = kRR'v'^2$. In c.g.s. units the constant $k = 4{\cdot}313 \times 10^{-8}$.

The data for the twenty-six known satellites in the solar system necessary for calculating the planetary radii are tabulated, together with the deduced ratio of the radius of the planet to that of the earth compared with the measured values. The formula gives the radius of the earth with great accuracy, the ratio deduced/measured being 1·0001, according to our calculation; for Mars also the deduced radii are almost identical *inter se*, and with the measured value. For Jupiter and Saturn, whilst the deduced values are highly consistent among themselves, except that given by Saturn's ninth and most distant satellite, they are slightly in excess (approx. 6 per cent. and 2 per cent. respectively) of the measured radii. For Uranus and Neptune the formula gives results roughly 50 per cent. and 100 per cent. too high respectively.

PERIODICITIES IN PROMINENCES AND SUN-SPOTS COMPARED.—In this column in November last (vol. xcii., No. 2297, p. 302) reference was made to Mr. T. Royds's investigation on prominence periodicities by the periodogram method. In a recent Kodaikanal Observatory Bulletin (No. 34) he undertakes the task of trying to find out whether the well-established sun-spot periodicities, other than that of eleven years, exists or not in prominences. He limits himself to periodicities up to eleven years in this communication, and studies them by the periodogram method as before. The data used are those published by the Italian observers, and deal with all prominences more than 30″ in height recorded since 1871. A brief summary of his conclusions is as follows. The prominence periodogram is very similar to that of spots for the same time interval. Between two years and eleven years there are no periodicities present in prominences which can be proved to be absent from sun-spots and *vice versâ*. The eleven-year period is the predominant feature of the prominence periodogram, and its maxima occur about one year later than in sun-spots. The maxima of its first subperiod, 5·56 years, are not delayed in prominences. Periods between seven and eight years of considerable intensity in prominences have been shown to be present also in spots, but they are not permanently active. As regards shorter periods, that of thirteen months in prominences is not present in spots, and one of 8¼ months in spots is stated to disappear for a time and then reappear. In December last (NATURE, vol. xcii., No. 2301, p. 411) reference was made to Prof. A. A. Michelson's determinations of sun-spot periodicities by the harmonic analyser, but he could not find any periodicity other than that of eleven years.

THE TEACHING OF ANTHROPOLOGY AT THE UNIVERSITIES.

A JOINT committee of the Royal Anthropological Institute and Section H of the British Association, of which Sir Richard Temple is chairman, has had under consideration the steps desirable to give practical effect to the conclusions resulting from the discussion, which took place at the meeting of the British Association at Birmingham last September, on the practical application of anthropological teaching in universities. It will be remembered that it was held at Birmingham that increased facilities should be offered at our universities for training those who, in after life as officials, business men, missionaries, and the like, will be brought into close contact with the peoples of the Empire, whose civilisation is alien to our own. After careful consideration, the joint committee is of opinion that such facilities can best be offered by the collaboration of the Royal Anthropological Institute, the British Association, and the universities, with the support and the cooperation of the Government, the Foreign Office, the India Office, the Colonial Office, and the Civil Service Commissioners, and that it would be well for the organisation to take the form of encouraging the existing schools of anthropology in the universities and the formation of such schools, where none exist, with their indispensable adjuncts of laboratories, libraries, and museums.

In furtherance of the scheme thus elaborated a conference was summoned by the joint committee at the Drapers' Hall, by courtesy of the Master and Wardens of the Drapers' Company, on Thursday, February 19, under the chairmanship of the Earl of Selborne, K.G. Letters supporting the proposals of the conference were received from, among others, the Colonial Secretary, Lord Cromer, Sir Richard Martin, Sir Robert Blair, Sir George Grierson, Sir Joseph Larmor, M.P., Sir John Rhys, Sir Ernest Trevelyan, and the Right Honourable Ameer Ali. An encouraging feature was the presence of an official representative of the Colonial Office.

The following resolution was moved by Sir Henry Craik, M.P., seconded by Sir Everard im Thurn (Royal Geographical Society), and carried unanimously:—"That this conference approves the findings and views of the joint committee, and is of the opinion that, in the highest interests of the Empire, it is necessary so to extend and complete the organisation of the teaching of anthropology at the universities of Great Britain, that those who are about to spend their lives in the East, or in parts of the Empire inhabited by non-European races, shall at the outset of their career possess or have the opportunity of acquiring a sound and accurate knowledge of the habits, customs, social and religious ideas and ideals of the Eastern and non-European races subject to his Majesty the King-Emperor."

A second resolution, moved by Sir Hercules Read (British Museum), and seconded by Dr. T. H. Warren (Oxford University), was as follows:—"That this conference hereby authorises the chairman and members of the joint committee of the British Association for the Advancement of Science and the Royal Anthropological Institute, to represent to the Prime Minister, the Right Hon. Herbert Henry Asquith, K.C., M.P., the opinions of this conference as set forth in the preceding resolution, and to move him to appoint an Inter-departmental Committee for the purpose of advising as to the form in which the sympathy and support of his Majesty's Government can be best expressed." The resolution was carried unanimously.

All the speakers to the resolutions strongly endorsed the findings of the joint committee, and pointed out how seriously handicapped were young men in every walk of life, who went abroad without any anthropological training, amongst alien peoples, and it was only by the painful process of committing mistakes that they were enabled to get an insight into the habits and customs of those with whom they came into daily contact. The Hon. J. G. Jenkins (London Chamber of Commerce) bore testimony to the wastage of millions of pounds sterling in trade owing to this fact, as the mistakes constantly made by the untrained men, who were sent out by commercial firms, were made at the expense of the firms; in the case also of the untrained missionary, he stated that during his first years abroad ground was lost and good influence retarded until he began to get a knowledge of the people, finally, from his own experience as a Minister in the Government of South Australia, he laid strong emphasis on the necessity for State aid in the anthropological training of the youth of the Empire.

As Prof. Arthur Keith pointed out, the Royal Anthropological Institute has spent more than thirty years in collecting information, so that the knowledge is available, but it is the dissemination of this knowledge that is necessary, and to achieve this object the institute had been trying for the last twenty years to induce the Imperial Government to help by means of financial support.

Dr. J. G. Frazer (British Science Guild) mentioned that it was largely due to the lack of anthropological training that the recent outbreak occurred in Somaliland, and this is not the first occasion on which loss of life and money has been attributed to the same cause.

In the interests of the Empire it is earnestly to to be hoped that Dr. Warren will prove a true prophet and official support will be given in a matter of such vital importance, and that a scientific system of anthropological training will be the outcome of the conference, and thereby crown with success the labours of the joint committee and of its indefatigable secretary.

COLOUR VISION AMONG CRUSTACEA.

WHETHER the lower animals have colour-perception is a question that has long been discussed without conclusive evidence being forthcoming. Paul Bert and the late Lord Avebury may be cited amongst those who claimed by their experiments proof of a colour-sense in Daphnia, whilst other investigators, among the most recent being C. Hess, conclude that what appear to us as colours are to these lower Crustacea only degrees of brightness; that, in fact, these animals are in the position of a colour-blind man, and choose what are to him and them the brightest part of the spectrum.

A recent issue of the *Biologisches Centralblatt* (vol. xxxiii., No. 9, 1913) contains an interesting and careful piece of experimental evidence on the behaviour of Daphnia and of Artemia to white and to monochromatic light. By the aid of a specially devised mode of illumination (a 100 candle Osram lamp and fluid light-filters or coloured glass screens) Dr. von Fritsch and Herr Rupelwieser have been able to make a more critical test of the responses of these Crustacea than was possible to most of their predecessors in this line of research. Working with white light (whether vertically or horizontally) these authors find that Daphnia remains evenly distributed under the influence of a medium light-intensity, but that it moves away from the source of light if the brightness of this is raised, and towards the light if the intensity is lowered. In this respect the work of the authors merely confirms similar observations already published.

If now a blue screen be interposed the Daphnia, in spite of the lowered intensity, move away from the light. On the other hand, if a yellow screen is used the Daphnia move towards the light, although its intensity is greater and is such as would ordinarily induce a negative reaction. On these and other grounds the authors conclude that Daphnia has a colour-sense and not merely a perception of varying degrees of light intensity. Red, yellow, and green rays attract Daphnia; blue-green, blue and violet rays repel Daphnia.

The whole question has been dealt with more fully by the late Lord Avebury in his "Senses of Animals" (International Science Series, vol. lxv., 1889) than the German authors give that distinguished naturalist credit for, and indeed they refer only to his earlier paper (1881). Both the German and the English authors arrive at similar conclusions, though Lord Avebury used a method of choice which was not employed by these most recent workers.

One further point of interest is the varying degrees of response given by strains of the same species and of different species of Daphnia. For example, in testing the effects of coloured light upon the eye, a very definite response was at first found to occur in red light, and quite another in blue light; but when the observers tried to repeat this effect on another batch of Daphnia, they were unsuccessful in obtaining a strain which responded so well as the first, until after six months' trials. *Daphnia magna* was found to give more consistent results than the common *Daphnia pulex*.

F. W. G.

ORNITHOLOGICAL NOTES.

AT the conclusion of a note on the food and feeding habits of the pheasant, published in the Journal of the Land Agents' Society for December, 1913, Mr. W. E. Collinge states that the greater portion of the food of these birds consists of injurious insects and the seeds of weeds, the statement being based on the examination of the contents of the crops and stomachs of no fewer than 183 birds. Pheasants daily wander over large areas of land in search of food, and—altogether apart from their value as game—merit protection on the part of all persons interested in agriculture. Although they occasionally snip the leaves of root crops, especially in very dry weather, most of the damage of this nature laid to their charge is really caused by wood-pigeons.

The difficult question as to whether "willow-tits," as typified by *Parus borealis*, are really entitled to specific distinction from "marsh-tits" (*P. palustris*), is discussed by Mr. Collingwood Ingram in *The Zoologist* for November, 1913, in connection with their respective French representatives. Provisionally, the author considers it expedient to recognise this distinction, the marsh-tits being characterised by the steely-blue sheen on the crown, whereas in the willow-tits this is replaced by dull brownish or sooty black.

The list of casual visitors to the British Isles has been augmented by the capture on October 3, 1913, of a specimen of the dusky warbler (*Phylloscopus fuscatus*) on Auskerry, in the Orkneys. The capture was recorded by Mr. Eagle Clarke in the *Scottish Naturalist* for the same year (pp. 271–3), and is more fully noticed in *British Birds* for January, 1914 (pp. 220–3). The species breeds in eastern Siberia, and visits southern China, northern India, Burma, &c., in winter.

In *British Birds* for December last Mr. G. R. Humphreys records the breeding of the rosy tern, *Sterna dougalli*, during the past summer in Ireland, where these birds have hitherto been supposed to be extremely rare. In the breeding-place referred to by the author they were, however, met with in comparatively large numbers. The identification of the species is based on the examination of the parent birds with field-glasses, and on the colouring of the nestlings—notably of the legs—which is stated to be very markedly distinct from that of other terns at the same age.

Further particulars with regard to the number of birds "ringed" during the past season in this country and records of their recapture are given by Mr. H. F. Witherby in the above-mentioned issue of *British Birds*. The total number is 14,843, against 11,483 in 1912, and 2171 in 1909. The present percentage of recaptures (Mr. Witherby uses the word "recoveries," which suggests a meaning different from the one intended) is 3·3 per cent., on a total of more than 30,000; but as many of such recaptured birds afford no data of any importance, the percentage yielding information of scientific value falls short of three.

To vol. xxxv. (pp. 209–23) of Notes from the Leyden Museum, Dr. E. D. van Oort communicates further particulars with regard to the recapture of birds ringed in Holland. Perhaps the most interesting items relate to a couple of spoonbills, one of which was shot in the Azores and the other in Portugal.

The bird-life of the coast in the neighbourhood of Bergen forms the subject of an article, illustrated by very interesting photographs of nests and nesting-sites, by Mr. O. J. Lie-Pettersen, in the November number of *Naturen*.

Bird-Lore for November and December, 1913, is a highly attractive issue of an ever-popular journal, the two coloured plates of well-known American birds being well worth the price of the whole part. An editorial article alludes to the striking advances which have been made in the protection of American birds during the past year, while other articles mention the work done by the various Audabon societies, these being supplemented by the reports of local agents.

A remarkable difference in the plumage of male hybrids between the common pheasant and Reeves's pheasant, according as to whether the first or second species was the male parent, and *vice versâ*, is recorded by Mr. J. C. Phillips, in *The American Naturalist* for November, 1913. So different, indeed, are these two types of hybrids, that they might well be regarded as distinct species. In the cross with the Reeves as male parent that species impressed its characters much more strongly on the hybrids than was the case with the opposite cross. As the progeny of such a cross are generally sterile, the crossing could not be further continued.

The biological survey division of the U.S. Department of Agriculture has issued, as Bulletin No. 43, a useful list of literature relating to the food of birds published by the members of the survey between the years 1885 and 1911. Also, as Circulars Nos. 92 and 93, proposed regulations for the protection of migratory birds, with a popular explanation of their scope and probable effect. The scheme includes uniformity in protection of migratory game and insectivorous birds in the several States; protection of birds in spring, while *en route* to their nesting grounds and while mating; uniformity in protection of migratory birds at night; establishment of protected migration routes along three great rivers in the central United States; complete protection for five years for the smaller shore-birds and species which have been greatly reduced in numbers; and reduction of the open season on migratory game-birds, to the extent, in most cases, of not more than from 25 to 50 per cent.

In Nos. 2 and 3 (issued together) of the *Austral Avian Record*, Mr. G. M. Mathews proposes no fewer than twenty-one new generic names for Australasian birds, in addition to certain others to replace inadmissible ones. In this "splitting" are included the genera Sula, hitherto taken to comprise all the gannets, and Phæthon, the accepted term for all the tropic-birds. Other species and races are named in No. 4 of the same volume.

Under the somewhat too generalised title of "Notes upon Some Rare New Zealand Birds," Mr. Symington Grieve communicates to vol. xix., No. 4, of the Proceedings of the Royal Physical Society of Edinburgh, an important article on the history, habits, distribution, and distinctive characters of the various species of Apteryx. Most of these birds are now very scarce, and it is believed that *A. haasti* has either been already exterminated, or is on the verge of extinction. The author alludes to all the species under the name of "kiwi," but, we believe, the Maoris restrict that title to certain species, designating the others "rowa."

To the number of *The Emu* for October, 1913, Mr. A. J. Campbell communicates an account, illustrated by three beautifully coloured plates, of an unrivalled collection of Australian birds'-eggs, brought together by Mr. H. L. White, of Beltrees, near the upper part of the Hunter River. Out of a total of between 800 and 900 species and subspecies recognised in the "Official Check-list of the Birds of Australia," Mr. White possesses the eggs of no fewer than 800, thus lacking only about 8 per cent. of the whole. It may be added that the Beltrees Estate, comprising about 200,000 acres, is a close sanctuary for birds, where many species are increasing in number.

In a paper on fossil feathers, published in No. 7 of vol. xxi. of *The Journal of Geology*, Dr. R. W. Shufeldt states that several specimens described as such have subsequently proved to be ferns. The authors figure a number of specimens or more or less well-marked impressions of feathers, from those of Archæopteryx upwards. R. L.

THE INDIAN MUSEUM AND SCIENCE CONGRESS.

CALCUTTA was the scene last month of a celebration of considerable importance to all who are interested in the progress of science in the East. The trustees of the Indian Museum resolved to commemorate in a fitting manner the centenary of the premier museum in Asia, and a short account of its proceedings will no doubt be of interest to those who were not privileged to take part in them.

The celebrations happily coincided in time with the first Indian Science Congress, the meetings of which were appropriately held in the rooms of the Asiatic Society on January 15–17.

At the opening meeting of the congress, the Hon. Justice Sir Asutosh Mukerji presided. Sir A. Mukerji, in his opening address, said that more than two years ago Prof. MacMahon, of Canning College, Lucknow, and Prof. Simonsen, of the Presidency College, Madras, brought forward a proposal for the foundation of an Indian Association for the Advancement of Science. The object and scope of the proposed institution were stated to be similar to those of the British Association, namely, to give a stronger impulse and a more systematic direction to scientific inquiry, to promote the intercourse of societies and individuals interested in science in different parts of the country, to obtain a more general attention to the objects of pure and applied science, and the removal of any disadvantages of a public kind which may impede its progress. The proposal was widely circulated, and met with a favourable reception. It was felt by many men of experience that the pressure of heavy official duties, the climatic conditions which prevail in the country, and the long distances which have to be traversed, constitute practical difficulties in the immediate formation of a peripatetic association designed to meet periodically in turn in all the different centres of scientific activity. The call to scientific workers met with a generous response, as was amply indicated by the presence at the congress of many notable investigators from all parts of the Indian Empire.

The reading of papers commenced at the conclusion of the address, and in the course of the congress a number of important communications were made in various departments of science. The chairmen of the various sections were:—*Chemistry*, Prof. P. S. MacMahon; *Physics*, Prof. V. H. Jackson; *Zoology*, Dr. J. R. Henderson; *Geology*, Dr. H. H. Hayden; *Botany*, Mr. C. C. Calder; *Ethnography*, Mr. L. K. Anantha Krishna Iyer. Mr. D. Hooper, of the Indian Museum, was honorary secretary and treasurer of the congress.

The centenary celebrations of the Indian Museum commenced on the afternoon of January 15, by a reception of delegates at the rooms of the Asiatic Society. His Excellency Lord Carmichael, Governor of Bengal, who took a keen interest both in the museum celebrations and in the congress, was present as chairman of the centenary committee, and took the chief part in receiving the delegates.

The Indian Museum owes its inception to the Asiatic Society of Bengal, which was founded by Sir William Jones in 1784. Donations of various kinds having gradually accumulated in the society's premises, Dr. N. Wallich, the Danish botanist of Serampore, wrote, on February 2, 1814, a letter to the society strongly advocating the formation of a museum. This proposal was forthwith accepted. The scope of the museum was defined in the widest terms, and contributions throwing light on the history or science of the East were solicited. The museum thus inaugurated made rapid progress, and the specimens brought together were housed until 1875 in the rooms still occupied by the Asiatic Society of Bengal. In 1875 the collections were transferred by the society to the fine building which had been erected for their reception on Chowringhee, the main thoroughfare of Calcutta. Since then, through the labours of distinguished superintendents, viz., Dr. John Anderson, Mr. J. Wood-Mason, Lieut.-Col. A. Alcock, and Dr. N. Annandale, progress has been rapid and continuous. Considerable extensions to the original building have been found necessary, and, thanks to the unrivalled Oriental collections and to a very complete library, the museum is not only a great educational institution, but also an important centre for research, especially in zoology and geology.

The celebrations terminated in a very successful conversazione held in the Indian Museum on January 17. The company present included their Excellencies Lord and Lady Carmichael, and a representative selection of the European and Indian communities of Calcutta, as well as the delegates and the members of the Science Congress. An extremely interesting series of exhibits had been arranged by the officers of the museum, comprising archæological, art, botanical, ethnological, geological, and zoological specimens, and brief reference may be made to some of the more important of these.

Prominent among the archæological exhibits was one to illustrate the evolution of the Buddha image, commencing with the Gandhara or Indo-Greek school, and continuing with the later types from Mathura, Amarawati, Sarnath, Bengal, Tibet, and Further India. The botany and ethnology of the Abor country, visited by a punitive expedition in 1911–12, were illustrated by specimens exhibited by Messrs. Hooper, Kemp, and Coggin Brown. The geological series lent by the Geological Survey of India comprised characteristic Indian fossils exhibited by Dr. G. E. Pilgrim.

The zoological exhibits, which were very numerous, attracted a large share of attention. Prominent among them was a series of deep-sea animals dredged by the R.I.M.S. *Investigator*, exhibited by Major Lloyd and Captains Seymour Sewell and T. L. Bomford, and comprising fish, crustacea, mollusca, echinoderms, and corals. Remarkable fresh-water invertebrates recently discovered in India were exhibited by Dr. Annandale and Messrs. Kemp, Gravely, and Agharkar, and included the very interesting medusa (*Limnocnida indica*), discovered three years ago in the upper waters of the River Kistna in the Western Ghats. Recently discovered Indian fresh-water fishes and specimens of the fresh-water sting-rays of the Ganges were shown by Dr. Chaudhuri. Dr. Annandale exhibited a series of specimens to illustrate a paper which he read before the Science Congress on convergence in aquatic animals. Convergence in skeletal structure was shown between different fresh-water sponges, and in the special form of spicules in different families of sponges, while the same phenomenon was also illustrated in the degeneracy of calcareous plates in the stalked barnacles, in the form of shell between the marine oysters and the fresh-water family Aetheriidæ, in degeneration of the eyes in the Indian electric rays, in the independent evolution of pigmentation of the ventral surface in different deep-sea rays, in general form between certain carp of the Himalayas and Tibet and the Salmonidæ, and in the independent evolution of adhesive suckers in different tadpoles and fishes inhabiting rapid-running streams. Mr. Kemp exhibited zoological specimens from the Abor country, the expedition to which he accompanied in the capacity of naturalist, among them being the Peripatus (*Typhloperipatus williamsoni*), which he discovered, the first representative of the group to be met with north of the Isthmus of Kra in the Malay Peninsula. A small but interesting collection of type-specimens of Asiatic squirrels containing the type of *Funambulus layardi*, Blyth, mounted in the Asiatic Society's Museum seventy years ago, was exhibited to prove that it is possible to preserve mammal skins in Calcutta for an indefinite period, if proper precautions are taken.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The trustees of the John Feeney bequest have granted to the University the sum of 1000*l*. in aid of research and instruction in wireless telegraphy. The money is to be applied to the erection of a wireless telegraphic installation on the University buildings at Edgbaston.

CAMBRIDGE.—Dr. Hobson, Sadleirian professor of pure mathematics, has been nominated to represent the University on the occasion of the celebration on June 29–30 and July 1 of the three hundredth anniversary of the foundation of the University of Groningen.

The Vice-Chancellor announces that Mrs. A. M. Babington has expressed the wish to defray the cost of the gallery which is being built to house the exhibit of local antiquities. This gallery, which will be known as the "Babington Gallery," is being erected to the memory of the donor's husband, Prof. Babington, of St. John's College, and professor of botany in the University. It was Prof. Babington who, in the early forties of last century, initiated the Cambridge Antiquarian Museum, which forty years afterwards ceded to the University. The extent of Mrs. Babington's benefaction will amount to 1550*l*.

The University Buildings Syndicate has had under consideration the question of providing a central electric power station to supply the numerous science and other buildings on either side of Downing Street. At the present moment there is an assortment of engines supplying these various laboratories, but the system has many inconveniences, and is costly and extravagant. The syndicate wishes to be authorised to expend a sum not exceeding 3000*l*. in providing a power station in connection with the engineering laboratory, and also to enter into a contract with the Cambridge Electric Supply Company for the supply of electricity for a period of ten years.

The next combined examination for fifty-three entrance scholarships and a large number of exhibitions, at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 1, 1914, and following days. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical science to compete for scholarships and exhibitions by taking the papers set in mathematics and natural sciences. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained.

MR. S. HEY, secretary to the Education Committee of Newcastle-upon-Tyne, has been appointed director of education for Manchester in succession to the late Mr. C. H. Wyatt.

IT is announced in *Science* of February 13 that Bowdoin College has received a bequest of 100,000*l*. for the general fund of the college from the estate of the late Mr. Edwin B. Smith, former assistant attorney-general of the United States, who died in New York on January 5. It is stated in the same issue of our contemporary that, through the will of the late Mrs. Elizabeth Mattox, of Terre Haute, the sum of 9000*l.* will be added to the general endowment of De Pauw University; and that Mrs. W. P. Herrick, widow of the late Mr. W. P. Herrick, has given to the University of Colorado 1000*l.*, to be used as an aid fund for worthy students.

A BILL was read a second time in the House of Commons on February 20 to amend the law in respect of the employment of children and their attendance at school. The principal changes in the law proposed are the grant of optional powers to local education authorities to extend the age of leaving school from fourteen years to fifteen; no exception from school attendance to be allowed for children under thirteen years; the abolition of the existing half-time system; the grant to local education authorities of power to require attendance at continuation classes; and the prohibition of street trading by boys under fifteen and girls under eighteen. The subject of the continuation-school system was referred to by Lord Haldane in replying to the toast of "His Majesty's Ministers," at the dinner of the City of London Solicitor's Company on the same date. He said the old days of apprenticeship which did so much for us have long since gone by. Continental nations, and in a less degree the United States, are substituting for apprenticeship a very formidable thing—training in the trade continuation schools. A British workman finishes his education at thirteen. In many parts of the Continent that training is now going on until sixteen, seventeen, and eighteen; and not a training merely in general education, but in the chief point of the calling which the workman is going to exercise in the future. We shall have to face this in six or seven years from now. The London County Council is awake to the national peril, and that is true of other great cities in the United Kingdom. Lord Haldane is a firm believer in our capacity to keep our lead, but only if we think ahead and act ahead. We cannot afford to be inattentive to these things, and be slack as to the consequences. A national awakening will come, and it is our duty to see that it does not come too late.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 19.—Sir William Crookes, president, in the chair.—Prof. G. Elliot **Smith**: The brain of primitive man, with special reference to the cranial cast and skull of Eoanthropus ("the Piltdown man"). The small brain of Eoanthropus, though definitely human in its characters, represents a more primitive and generalised type than that of the genus Homo. Nevertheless, it can be regarded as a very close approximation to the kind of brain possessed by the earliest representatives of the real Homo, and as the type from which the brains of the different primitive kinds of men—Mousterian, Tasmanian (and Australian), Bushman, negro, &c., no less than those of the other modern human races have been derived, as the result of more or less well-defined specialisations in varying directions. From the features of its brain Pithecanthropus must be included in the family Hominidæ, but it and Eoanthropus can be looked upon as divergent specialisations of the original genus of the family. Pithecanthropus represents the unprogressive branch which survived into Pleistocene times before it became extinct; Eoanthropus the progressive phylum from which the genus Homo was derived. Special attention is devoted to the study of the temporal region of the brain, which in all of these fossil men (not excluding Pithecanthropus) reveals features of great morphological interest. The opinion is expressed that the increased size of the brain (as a whole) which is distinctive of the Hominidæ, among the Primates, is ultimately related to the acquisition of the power of articulate speech, and that the very earliest representatives of the family must have possessed in some slight degree the definite faculty of intercommunication one with another by means of vocal sounds. The development of asymmetry of the brain was necessarily incidental to the acquisition of human characteristics, and must have been already present in the original Hominidæ.—Prof. A. J. **Ewart**: Oxidases.—Dr. J. W. W. **Stephens**: A new malarial parasite of man. The blood-slide in which this parasite occurred came from Pachmari, Central Provinces, India. The peculiarities of the parasite are:—(1) It is extremely amœboid. Thin processes extend across the cell or occur as long tails to more or less ring-shaped bodies. These processes may be several in number, giving the parasite fantastic shapes. (2) The cytoplasm is always scanty; the amœboid processes are delicate; the parasite has but little bulk. (3) The nuclear chromatin is out of proportion to the bulk of the parasite. It takes the form of bars, rods, strands, curves, forks, patches, &c. Abundance of and marked irregularity in the distribution of the chromatin masses are characteristic of this parasite. It differs from the hitherto described parasites of malaria. The author proposes to call the parasite *Plasmodium tenue*.—S. B. **Schryver**: Investigations dealing with the phenomena of "clot" formations. Part ii., The formation of a gel from cholate solutions having many properties analogous to those of cell membranes.—Dorothy J. **Lloyd**: The influence of the position of the cut upon regeneration in *Gunda ulvae*. In 1889, Hallez published a paper in which he stated that the difference in the regeneration of Triclads and Polyclads lay in the fact that the former could regenerate a head from the oral surface of a cut made at any level, while the latter could only do so if the regenerating fragment contained the cerebral ganglia. Experiments made with *G. ulvae*, a marine Triclad occurring in large numbers at Plymouth, show that this generalisation is not justifiable. *G. ulvae* is found to differ from most Triclads and to correspond to Polyclads in its mode of regeneration.

Geological Society, February 4.—Dr. Aubrey Strahan, president, in the chair.—C. T. **Trechmann**: The lithology and composition of Durham Magnesian Limestones. The formation maintains a highly dolomitic character, with important exceptions. Those portions which show a calcareous composition may be regarded as the result of one of three main causes:—(1) Original conditions of sedimentation, during which dolomitic deposition was arrested temporarily; (2) escape from secondary dolomitisation; (3) calcareous segregation. Evidence is brought forward in favour of the view of direct sedimentation of dolomite from the waters of the Permian sea. The question of the secondary dolomitisation of the Shell-Limestone reef is discussed. The dedolomitisation of the formation is due to the mechanical washing-away of powdery dolomitic material through the interstices of the rock. No evidence of any leaching-out of magnesium carbonate from the rock was found. The nature and distribution of the true cellular rock is discussed, and modes of origin are suggested. A summary of the general conditions of deposition of the Durham Permian, from the Marl Slate upwards to the Salt Measures, is given.—H. **Bolton**: The occurrence of a giant dragon-fly in the Radstock Coal Measures. The structure of a wing-fragment found upon the Tyning waste-heap at Radstock Colliery (Somerset), is described. The fragment consists of the proximal third of a left fore-wing. It is 64 mm. long and 40 mm. broad, the complete wing having an estimated length of 190 mm., or 7·5 in.; the whole insect (with wings extended) must have had a span of more than 400 mm., or 16 in. The anterior wing-margin is tuberculated proximally, and more distally bears a closely set series of pointed spines directed outwards towards the wing-apex. The hinder wing-margin is also spinous, the spines possibly serving to interlock the fore and hind wings during flight. The characters of the costa and subcosta on the anterior portion of the wing, and of the cubital and anal veins on the hinder part, show the relationship of the insect to the family Meganeuridæ. The wing is referred to the genus Meganeura as a new species.

EDINBURGH.

Royal Society, January 19.—Prof. Geikie, president, in the chair.—Prof. R. J. A. **Berry** and Dr. A. W. D. **Robertson**: The place in nature of the Tasmanian aboriginal as deduced from a study of his calvaria. Part ii., His relation to the Australian aboriginal. Among the main conclusions of this prolonged study of more than a hundred skulls may be mentioned the following. The Australians and Tasmanians are the descendants of a common Late Pliocene or Early Quaternary stock, which may be called, with Sergi, *Homo tasmanianus*; the Tasmanian aboriginal was the almost unchanged offspring of this type, but the Australian aboriginal is a cross between the primitive *Homo tasmanianus* and some other unknown race, and is therefore a hybrid; both races have evolved on their own lines, and in their own way; both have attained morphologically to a higher stage in the evolutionary scale than is usually supposed; neither have any direct relationship with *Homo primigenius* as represented by the crania of the Spy-Neanderthal men; the range of variability is, in the Australian, as great as in any other impure race; but in the Tasmanian it is as small as in any other known or supposed pure race.—L. W. G. **Buchner**: A study of the curvatures of the Tasmanian aboriginal cranium. This detailed craniometrical investigation led to the same conclusion come to by the authors of the previous paper on quite other grounds, namely, that the range of variation is so small as to warrant the belief that the Tasmanian is a pure race.—E. M. **Anderson**: The path of a ray of light in a rotating homogeneous and isotropic solid. By an interesting geometrical demonstration the paths are shown to be circles for rays travelling in planes at right angles to the axis of rotation.—T. J. **Evans**: The anatomy of a new species of Bathydoris and the affinities of the genus (Scottish National Antarctic Expedition). This species, dredged in 1410 fathoms off Coats Land, differs from the five known species in having only two gills, which are intermediate in condition between a typical Dorid rosette of plumes and a Tectibranch gill.—Prof. **Carlgren**: The genus Porponia and related genera (Scottish National Antarctic Expedition). The detailed examination of the many specimens which were dredged off Coats Land in a depth of 1410 fathoms showed that Porponia belongs to an elementary group of Actinians, or even to the Protactiniæ, but is in no way closely related to the Zoanthidæ, as Hertwig suggested in his *Challenger* report. With Porponia in the family Endocœlactidæ, Prof. Carlgren associates Halcurias and the new genus Synhalcurias, created for the species *Ilyanthopsis longifilis*.

PARIS.

Academy of Sciences, February 9.—M. P. Appell in the chair.—P. **Appell** and J. Kampé de **Fériet**: The convergence of series proceeding according to Hermite polynomials or more general polynomials.—Fred **Wallerant**: The crystallographic properties of dichlorobenzene.—Gaston **Bonnier** and Jean **Friedel**: Anatomical remarks on some types of carpophores.—O. **Lehmann**: A sudden change in the form of liquid crystals, caused by a molecular transformation.—Jean **Boccardi**: The diurnal variations of latitude.—A. **Véronnet**: The sun and its heat. Its contraction and its duration.—Ch. **Gravier**: Simplification of the method of obtaining a photographic negative.—Eugène **Darmois** and Maurice **Leblanc**, jun.: The working of the alternating arc in mercury vapour. An extension of the results published in an earlier paper. The current consumption is satisfactory, but the power factor is low. The present paper deals with the influence on the power factor of variations in the current dimensions, of free surface of the electrodes, length of arc, pressure of mercury vapour, and shape of the tube.—MM. **Hanriot** and **Lahure**: Increasing and decreasing hardening of metals.—R. **Marcelin**: The influence of temperature on the velocities of transformation of physico-chemical systems.—G. **Vavon**: The reaction velocity of catalytic hydrogenation in presence of platinum black. The velocity of fixation of hydrogen by limonene in presence of platinum black depends upon the quantity of platinum present and also upon its condition. The latter can be modified by heating the metal to various temperatures.—Léon **Guillet**: New researches on the transformation points and the structure of nickel-chrome steels. The first series of alloys studied contained about 0·2 per cent. carbon, 2 per cent. nickel, and chromium varying from 0·06 per cent. to 10·2 per cent. The second series contained 4 per cent. nickel, chromium varying from 0 to 13·9 per cent. Details are given of the transformation temperatures, microscopic structure, resilience, and hardness for sixteen alloys.—Paul **Pascal** and A. **Jouniaux**: The density of some metals in the liquid state. The densities of fused tin, lead, zinc, antimony, aluminium, and copper were taken at temperatures between their melting points and 1300° C. by means of a loaded fused quartz bulb. Formulæ are given for the expansion of these six metals in the fused state. The curve of specific volumes of tin shows a marked inflection at 620° C.—Alberto Betim Paes **Leme**: The zeolites of the river Peixe, Brazil.—Jean **Daniel**: The descendants of beans which have presented a case of xenia (influence of the embryo on the teguments of the seed).—Jakob **Eriksson** and Carl **Hammarlund**: Attempts to immunise the hollyhock against the disease of mildew (*Puccinia malvacearum*). The introduction of a fungicide (copper sulphate) into the soil arrests or reduces the vitality of the fungus living in the latent state in the interior of the plant.—P. **Choux**: The genus Tanulepis at Madagascar.—Jules **Amar**: Fatigue cardiograms.—A. **Javal**: The variations of the electrical conductivity of the fluids of the organism. The variations in the electrical conductivity of blood serum, pleural liquid, cephalo-rachidian fluid, and other fluids from the body are in close relation with the amount of chlorides present.—Louis **Joubin**: Two cases of incubation in Antarctic Nemertians.—Jacques **Pellegrin**: The fresh-water Atherinideæ of Madagascar.—Edouard **Chatton**: Autogenesis of the nematocysts in Polykrikos.—MM. **Azëma** and **Jamot**: The geology of Ouadaï.—De Montessus de **Ballore**: The distribution of earthquakes on the globe.

February 16.—M. P. Appell in the chair.—E. **Jungfleisch** and Ph. **Landrieu**: Researches on the acid salts of the dibasic acids. The dextrorotatory camphorates. Various metallic *d*-camphorates. From a study of the *d*-camphorates of sodium, lithium, ammonium, barium, strontium, calcium, manganese, cobalt, and piperidine, the conclusions are drawn that the neutral camphorates are very stable in presence of water and do not undergo dissociation; the acid camphorates in presence of water give the free acid and the dimetallic camphorate.—A. **Laveran** and G.

Franchini: The natural infection of the rat and mouse by *Herpetomonas pattoni* by means of parasitic rat fleas. The experiments carried out under natural conditions of attack by the rat fleas are favourable to the view that the trypanosomes of vertebrates and Leishmania have the flagellæ of invertebrates for their origin.—André **Blondel**: The influence of the mounting of triphase transformers on the transport of energy at high voltages. A discussion of the best way of protection of the system against third harmonics.—V. **Grignard** and E. **Bellet**: The constitution of liquid and gaseous cyanogen chlorides. A study of the reactions of the gaseous and liquid cyanogen chlorides with various organo-magnesium halides suggests that the gaseous chloride probably possesses the carbamine constitution, $C \equiv N.Cl$, the liquid chloride the nitrile constitution $Cl-C \equiv N$.—Ed. **Imbeaux**: A new system of electrical funicular haulage of boats.—Serge **Bernstein**: The best approximation of analytical functions possessing complex singularities.—Harris **Hancock**: The generalised Eulerian function.—J. **Andrade**: Study of new methods of compensation of chronometers and some thermal adjustments. Three distinct methods of adjustment are described.—P. **Dosne**: The registration of radio-telegrams by means of Poulsen's telegraphone. The apparatus comprises an ordinary wireless receiver with a crystal detector and telephone, a microphone, and a Poulsen telegraphone.—Ch. **Leenhardt** and A. **Boutaric**: The heat of fusion of hydrated salts and hydrates in general. As a first approximation the heat of fusion of a hydrate is equal to the heat of fusion of the water it contains.—G. **Reboul**: The selective action of metals in the photo-electric effect. The experiment consisted in measuring the negative emissions produced by the total radiation of a source of ultra-violet light falling on plates of different metals, and also measuring the emissions when the light had passed through a thin film of silver. For eight metals out of ten, the results are in qualitative agreement with the values calculated from Lindemann's formula. Aluminium and zinc are exceptional in their behaviour under these conditions.—Georges **Claude**: The influence of the diameter on the difference of potential at the electrodes of neon tubes. Observation relating to the aurora borealis. For tubes varying from 5·6 to 67 mm. in diameter, the fall of potential in volts per metre of tube is inversely proportional to the diameter. For the 67 mm. tube, the drop in volts is less than corresponds to its diameter, and the author suggests that in very wide tubes the fall of potential becomes very small. This has a bearing on the phenomenon of the aurora, in which the discharges are of enormous sectional area.—C. **Cloarec**: The spontaneous alteration of liquid surfaces.—M. **Swyngedauw**: The resonance of the third harmonics in triphase current alternatives.—André **Kling** and A. **Lassieur**: The physico-chemical estimation of sulphates. The conductivity method proposed by Dutoit for the estimation of sulphates is shown to be inexact.—E. **Tassilly**: The velocity of diazotation of some amines.—A. **Ariès**: The laws of displacement of chemical equilibrium.—M. **Barre**: Some double chromates.—S. **Wologdine** and B. **Penkiewitsch**: The heat of formation of manganese sulphide. The combination of finely divided manganese and sulphur was brought about by an aluminium-potassium chlorate fuse in an atmosphere of nitrogen. The mean result was 723 calories per gram of MnS formed.—A. **Colani**: The preparation of molybdenum metaphosphate, $Mo(PO_3)_3$.—Jacques **Joannis**: The catalytic influence of kaolin on the combination of hydrogen and oxygen. In the presence of kaolin, the combination of hydrogen and oxygen commences at 230° C.—E. E. **Blaise**: Syntheses by means of the mixed zinc organometallic derivatives. The 1 : 4-acyclic ketones. Succinyl chloride reacts with zinc alkyl iodides as though it possessed an unsymmetrical constitution, but starting with mixed cyctoacetals, the reaction gives rise to di*cyclo*acetals; from the latter 1 : 4-diketones can be obtained. The preparation of dipropionylethane by this method is described in detail.—Marcel **Godchot**: The synthesis of a methyl*cyclo*pentenone.—W. **Russell**: The survival of plant tissues after freezing. The death of a plant through frost rarely takes place suddenly, and appears to take place cell by cell.—V. **Lubimenko**: Researches on the pigments of the chromoleucites.—A. **Pézard**: The experimental development of the spurs and growth of the comb in hens. The extirpation of the ovary causes a growth in the spurs and diminution in the size of the comb.—Henri **Bierry** and Mlle. Lucie **Fandard**: Protein sugar and virtual sugar.—A. **Trillat** and M. **Fouassier**: Removal and separation of micro-organisms in suspension in water under the influence of an air current. Some organisms, such as *B. prodigiosus*, are readily carried away by an air current from a suspension in water; others, such as *B. subtilis*, are not removed. This property has been applied successfully to microbial separations.—W. J. **Penfold** and H. **Violle**: Sensibility of the organism to certain bacterial products caused by hæmolysis.—R. **Goupil**: Researches on the fatty matters formed by *Amylomyces rouxii*.—Jean **Groth**: The goniatite schists of Guadalmez.—J. **Repelin**: The secondary accidents which have affected the *massif* of Lare, near Sainte-Baume.

BOOKS RECEIVED.

Die Vögel. By A. Reichenow. Zwei Bände. Erster Band. Pp. viii+529. (Stuttgart: F. Enke.) 15 marks.

The Wonders of Bird-Life. By W. P. Westell. Pp. 128. (Manchester: Milner and Co.) 1*s*. net.

Transactions of the Geological Society of South Africa. Vol. xvi. Pp. 166+xxii plates. (Johannesburg.) 42*s*.

Proceedings of the Geological Society of South Africa. Pp. lxxviii+plates. (Johannesburg.)

Bill's School and Mine: a Collection of Essays on Education. By W. S. Franklin. Pp. vii+98. (South Bethlehem, Penn.: Franklin, Macnutt and Charles.) 50 cents.

Photo-chemistry. By Dr. S. E. Sheppard. Pp. x+461. (London: Longmans and Co.) 12*s*. 6*d*.

Library of Congress. Report of the Librarian of Congress and Report of the Superintendent of the Library Building and Grounds for the Fiscal Year ending June 30, 1913. Pp. 269. (Washington: Government Printing Office.)

Carnegie Endowment for International Peace. Division of Intercourse and Education. Some Roads towards Peace. A Report to the Trustees of the Endowment on Observations made in China and Japan in 1912. By C. W. Eliot. Pp. 88. (Washington, D.C.)

Ministerio da Agricultura, Industria e Commercio. Annuario publicato pelo Observatorio Nacional do Rio de Janeiro, 1914. Anno xxx. Pp. vii+360. (Rio de Janeiro.)

Plane and Spherical Trigonometry (with Five-Place Tables). By Prof. R. E. Moritz. Pp. xvi+357+67+96. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Fuel: Solid, Liquid, and Gaseous. By J. S. S. Brame. Pp. xv+372. (London: E. Arnold.) 12*s*. 6*d*. net.

Elasticità e Resistenza dei Corpi Pietrosi. Mattoni, Pietre, Malte e Calcestruzzi, Murature. By A. Montel. Pp. v+180. (Torino: S. Lattes and C.) 5 lire.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin Trimestriel des Résultats Acquis Pendant les Croisieres Périodiques et dans les Periodes Intermediaires. Publié par le Bureau du Conseil. Résumé des Observations sur le Plankton. 1902–8. Troisième Partie. Pp. 251–600+xxxviii–cv plates. (Copenhague: A. F. Host et Fils.)

Further Studies concerning the Methods of Calculating the Growth of Herrings. By E. Lea. Pp. 36. (Copenhague: A. F. Host et Fils.)

Rapports et Procès-Verbaux des Réunions. Vol. xviii. Rapports. Pp. 101. (Copenhague: A. F. Host et Fils.)

A Text-Book of Organic Chemistry. By Prof. A. F. Holleman. Edited by Dr. A. Jamieson Walker, assisted by Dr. O. E. Mott. Fourth English edition. Pp. xviii+621. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, February 26.

Royal Society, at 4.30.—The Diffraction of Light by Spheres of Small Relative Index: Lord Rayleigh.—(1) Studies of the Properties Operative in Solutions. XXXI. Sulphonic Acids and Sulphuric Acid as Hydrolytic Agents: A Discussion of the Constitution of Sulphuric and other Polybasic Acids and of the Nature of Acids. XXXII. The Influence of Sulphonates on the Hydrolytic Activity of Sulphonic Acids: A Contribution to the Discussion on the Influence of Neutral Salts: Prof. H. E. Armstrong and Prof. F. P. Worley.—Morphological Studies of Benzene Derivatives. V. The Correlation of Crystalline Form with Molecular Structure: A Verification of the Barlow Pope Conception of "Valency-Volume": Prof. H. E. Armstrong, R. T. Colgate, and E. H. Rodd.—The Magnetic Properties of Iron when Shielded from the Earth's Magnetism: Prof. E. Wilson.—The Occurrence of Ozone in the Upper Atmosphere: Dr. J. N. Pring.—(1) A Meteoric Iron from Winburg, Orange Free State; (2) The Electrification Produced during the Raising of a Cloud of Dust: W. A. D. Rudge.—The Electrical Ignition of Gaseous Mixtures: Prof. W. M. Thornton.

Concrete Institute, at 7.30.—Calculations and Details for Steel-frame Buildings from the Draughtsman's Standpoint: Cyril W. Cocking.

Institution of Electrical Engineers, at 8.—Motor and Control Equipments for Electric Locomotives: F. Lydall.

Society of Dyers and Colourists, at 8.—The Industrial Possibilities of Nitrocellulose: C. A. Higgins.—Notes on the Fading of Dyed Silk: A. Jones and G. W. Parr.

FRIDAY, February 27.

Royal Institution, at 9.—Surface Combustion: Prof. W. A. Bone.

Swedenborg Society, at 8.15.—The Body and the Soul in Swedenborg's Philosophy: Dr. L. de Beaumont-Klein.

Institution of Civil Engineers, at 8.—The Use of Reinforced Concrete in Connection with Dock and other Maritime Work: C. S. Meik.

Physical Society, at 8.30.—First Guthrie Lecture: Radiation of Gas Molecules Excited by Light: Prof. R. W. Wood.

SATURDAY, February 28.

Royal Institution, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

Essex Field Club (at the Essex Museum, Stratford), at 6.—Some Notes on the Vegetation of Boulder-Clay Wastes in North Essex: G. Morris.—Oysters, Pliocene to Recent. A. Bell.—Scientific Surveys: Rev. C. H. Grinling.

MONDAY, March 2.

Society of Chemical Industry, at 8.—The Bleaching of Chemical Pulp and Suggestions for a Standard Method in Test Cases: A. Baker and J. Jennison.—Blasting Gelatine, some Notes and Theories: W. A. Hargreaves.—An Application of Calcium Carbide to the Formation of Alloys: W. R. Hodgkinson.

Royal Society of Arts, at 8.—Artistic Lithography: J. Pennell.

Society of Engineers, at 7.30.—Esperanto: An International Language for Engineers: T. J. Gueritte.

Aristotelian Society, at 8.—The New Encyclopædists on Logic: Prof. J. Brough.

TUESDAY, March 3.

Royal Institution, at 3.—Modern Ships. I. Smooth Water Sailing: Sir John H. Biles.

Zoological Society, at 8.30.—Report on the Freshwater Fishes Collected by the British Ornithologists' Union Expedition and the Wollaston Expedition in Dutch New Guinea: C. Tate Regan.—The Nests of Pseudoscorpiones; with Historical Notes on the Spinning-organs and Observations on the Building and Spinning of the Nests: H. Wallis Kew.—Spiders from the Montebello Islands: H. R. Hogg.—The Skull of a Pariasaurian Reptile, and on the Relationships of that Type: D. M. S. Watson.—The Structure and Life-history of a Tape-worm (*Ichthyotaenia filicollis* Rud.) parasitic in the Stickleback: F. J. Meggitt.—Trematode Parasites from Animals Dying in the Zoological Society's Gardens during 1911–12: Dr. W. Nicoll.

Institution of Petroleum Technologists, at 8.—Introductory Remarks by the President: Sir Boverton Redwood.—Geometry of the Anticline: Sir Thomas H. Holland.—The Educational Aims of the Institution of Petroleum Technologists: E. H. Cunningham-Craig.—Petroleum Technology as a Profession: Prof. Vivian B. Lewes.

Institution of Civil Engineers, at 8.—*Further Discussion*: Rail-steels for Electric Railways: W. Willox.—Rail-corrugation and its Causes: S. P. W. D'Alte Sellon.

Royal Society of Arts, at 4.30.—*Discussion*: The Montreal, Ottawa, and Georgian Bay Canal: Sir R. W. Perks.

WEDNESDAY, March 4.

Society of Public Analysts, at 8.—The Composition and Analysis of Compound Liquorice Powder: A. E. Parkes and F. Major.—The Composition of the Saline Matter Adhering to Certain Wet Salted Skins: M. C. Lamb.—The Determination of Carbon Monoxide in Air: F. S. Sinnatt and B. J. Cramer.—A Suggested Simple Method for the Approximate Determination of "Stump" (Wood) Turpentine in American Gum Turpentine: L. M. Nash.—Dried Carica Papaya Juice: Dr. F. F. Shelley.

Aëronautical Society, at 8.30.—The Rational Design of Aëroplanes: A. R. Low.

Entomological Society, at 8.

Royal Society of Arts, at 8.—Travels in the Balkan Peninsula: H. C. Woods.

THURSDAY, March 5.

Royal Society, at 4.30.—*Probable Papers*: The Action of Light on Chlorophyll: H. Wager.—Formaldehyde as an Oxidation Product of Chlorophyll Extracts: C. H. Warner.—The Controlling Influence of Carbon Dioxide in the Maturation, Dormancy, and Germination of Seeds: F. Kidd.—The Functional Correlation between the Ovaries, Uterus and Mammary Glands in the Rabbit, with Observations on the Oestrous Cycle: J. Hammond and F. H. A. Marshall.—The Chromaffine System of Annelids and the Relation of this System to the Contractile Vascular System in the Leech, *Hirudo medicinalis*: Dr. J. F. Gaskell.

Royal Institution, at 3.—Heat and Cold: Prof. C. F. Jenkin.

Child Study Society, at 7.30.—The Sense of Humour in Children: Miss C. C. Graveson.

Linnean Society, at 8.—Results of Crossing *Euschistus variolarius* and *E. servus* with Reference to the Inheritance of an Exclusively Male Character: The Misses K. Foot and E. C. Strobell.—Short Cuts by Birds to Nectaries: C. F. M. Swynnerton.—Buprestidæ: Ch. Kerremans.—Platypodidæ and Ipidæ from the Seychelles: Lieut.-Col. Winn Sampson.—Scatopsidæ and Simuliidæ: Dr. G. Enderlein.—Heteroneuridæ—Milichiidæ: C. G. Lamb.

SATURDAY, March 7.

Royal Institution, at 3.—Recent Discoveries in Physical Science: Sir J. J. Thomson.

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